COLD-FORMED STEEL RESEARCH CONSORTIUM

SDII Building Archetype Design v1.0

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SDII
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About the authors

S. Torabian is a Research Scientist at Johns Hopkins University and the primary creator of version 1.0 of the Steel Diaphragm Innovation Initiative (SDII) building archetypes. Associate Professor M.R. Eatherton and Professor W.S. Easterling (Virginia Tech University) provided primary input on the composite beam design and BRB design. Professor J.F. Hajjar of Northeastern University contributed to the oversight and creation of the archetypes. Professor B.W. Schafer of Johns Hopkins University developed the basic framework for archetype selection, provided background on archetype needs, and contributed to the oversight and creation of the archetypes.

CFSRC Information

The Cold-Formed Steel Research Consortium (CFSRC) is a multi-institute consortium of university researchers dedicated to providing world-leading research that enables structural engineers and manufacturers to realize the full potential of structures utilizing cold-formed steel. More information can be found at www.cfsrc.org. All CFSRC reports are hosted permanently by the Johns Hopkins University library in the DSpace collection: https://jscholarship.library.jhu.edu/handle/1774.2/40427.

SDII Information

The Steel Diaphragm Innovation Initiative (SDII) is a multi-year industry-academic partnership to advance the seismic performance of steel floor and roof diaphragms utilized in steel buildings through better understanding of diaphragm-structure interaction, new design approaches, and new three-dimensional modeling tools that provided enhanced capabilities to designers utilizing steel diaphragms in their building systems. SDII was created through collaboration between the American Iron and Steel Institute and the American Institute of Steel Construction with contributions from the Steel Deck Institute, the Metal Building Manufacturers Association, and the Steel Joist Institute in partnership with the Cold-Formed Steel Research Consortium; including, researchers from Johns Hopkins University, Virginia Tech, Northeastern University, and Walter P Moore.

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Abstract

Building archetypes are fundamental to exploring and demonstrating the seismic behavior of modern structures. No suitable archetypes or prototypes exist in the open literature that focus on steel deck diaphragms for conventional steel buildings. Three dimensional building analysis, with meaningful contributions from the diaphragm in terms of behavior, has not formed the basis for modern seismic standards in steel at this time. The objectives for the SDII building archetypes include the following. Develop a series of 3D steel-framed archetype buildings that explore and document the design of horizontal lateral force resisting systems (LFRSs) with steel deck-based diaphragms as well as vertical LFRSs and the inter-relationship between the two. Provide a series of buildings that form a common basis of comparison for diaphragms in steel-framed buildings much the same way the SAC buildings did for the vertical LFRS. Explicitly explore the impact of the ASCE 7-16 standard, and ASCE 7-16 alternate diaphragm design with R_s=1 and R_s=3 in designs. Inform areas for needed experimentation, and create targets for advancing nonlinear analysis within the full SDII effort.

Version 1.0 of this archetype effort includes: (1) a complete slide deck explaining the design of a 12 story steel building archetype using buckling restrained braced (BRB) frames for the vertical LFRS and steel deck with fill for the diaphragm/horizontal LFRS detailed to the ASCE7-16 standard as well as the ASCE7-16 alternate diaphragm provisions with R_s=1 and R_s=3, (2) a series of spreadsheets that provide the complete design calculations for the gravity and lateral systems, (3) a series of computer models (using the SAP structural analysis program), and (4) a literature review of other related building archetypes and justification for developing new building archetypes.