## A formal approach to define HVAC sequence of operations to enable interpretation of the design intent for system behavior assessment

Graduate Student: Raghuram Sunnam, Phd student, CEE, CMU

Research Advisors: Burcu Akinci, Prof., CEE, CMU. Semiha Ergan, Asst. Prof., CEE, CMU.

## Motivation



➢ HVAC Systems accounted for 61% of the energy usage in the US in 2010 (12.57 Quadrillion Btus).[1]

>50% of the problems identified by LBNL in a study of 60 buildings were related to controls.[2]

➢HVAC control design intent is primarily transferred through textual narratives called Sequence of Operations (SOOs). [3] Frequency of common problems encountered in a 60 building study performed by LBNL (LBNL, 2002)

50%



Environmental

ENGINEERING

15%



A formalized approach to represent the information requirements of SOOs to enable unambiguous representation of HVAC system controls design intent.



## **References**:

[1] DoE, U. S. (2012). Building Energy Data Book. Washington, D.C., Energy Efficiency and Renewable Energy, Buildings Technologies Program, U.S. DoE.

[2] NBCIP, U.S. (2002). Building Energy Use and Control Problems: Defining the Connection, Ames. IA, National building controls information program, U.S. EPA
[3] Schein, J (2007). An information model for building automation systems. Automation in construction, 16(2), 125-139.
[4] Guideline, A. S. H. R. A. E. (2004). Guideline 13-2000 Specifying Direct Digital Control Systems. ASHRAE, Atlanta, GA.

