BSR/ASHRAE Addendum *i* to
ANSI/ASHRAE Standard 209-2018

First Public Review Draft

Proposed Addendum *i* to Standard 209-2018, Energy Simulation Aided Design for Buildings except Low-Rise Residential Buildings

First Public Review Draft (July 2024)
(Draft shows Proposed Changes to Current Standard)

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

This standard is under continuous maintenance. To propose a change to the current standard, use the change submittal form available on the ASHRAE website, www.ashrae.org.

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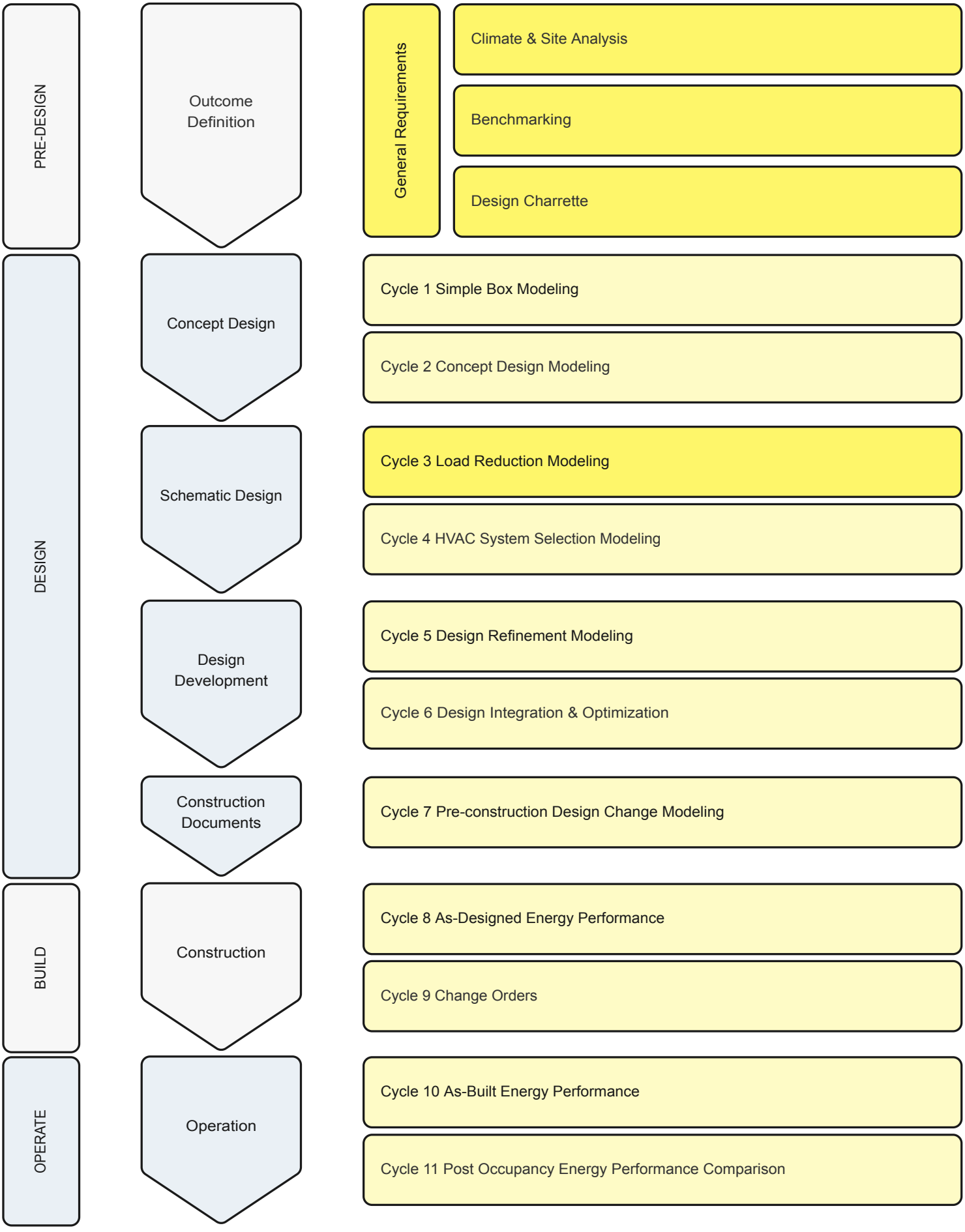
Informative Appendix X - Guidance in Design

The content of this appendix is intended to provide visual guidance regarding the structure and requirements of ASHRAE Standard 209. It is provided for informative purposes only and does not supersede any requirements in the body of the standard.

Informative Appendix X - Guidance in Design



PRE_ DESIGN

Outcome Definition

General Requirements

Climate & Site Analysis

- DB temp., RH or WB temp, Wind speed & direction, Insolation, Cloud cover, Ground temp., Precipitation, HDD & CDD
- Site characteristics impact on performance.
- Design strategies adapted to the local climate and site conditions.

Benchmarking

Energy use and costs of buildings with similar activities in the same climate

Design Charrette

Energy Baseline & Performance Goals

DESIGN

Concept Design Development

Cycle 1 - Simple Box

Form & Massing analysis → Orientation, WWR & skylights analysis → Envelope Thermal Performance analysis →

-Characteristics affecting performance the most
-Energy consumption breakdown
-Peak Heating & Cooling loads

Cycle 2 - Concept Design

-WWR
-Skylights
-Shading
-Daylighting
-Envelope thermal performance
-Natural Ventilation

Analyze variants of architectural concepts →

-Recommended Passive Design strategies for each concept
-Recommended building architecture
-Energy consumption breakdown
-Peak Heating & Cooling loads

DESIGN

Schematic Design Development

Cycle 3 - Load Reduction

-WWR
-Skylights
-Shading
-Daylighting
-Envelope thermal performance
-Thermal Mass
-Natural ventilation
-Energy Recovery
-Spatial design
-Equipment loads

Analyze peak reduction strategies →

Shortlist at least three peak load reduction strategies for baseline design
Recommend updated design concept with reduced loads
Energy consumption breakdown by end-use

Cycle 4 - HVAC Selection

HVAC CONCEPT Analysis → HVAC EQUIPMENT Analysis → HVAC SYSTEM Analysis → HVAC CONTROLS Analysis →

- Annual energy and demand impacts of HVAC system concepts
- Recommended HVAC system concept

-District/ Central Systems vs Distributed equipment
-Air cooled vs water cooled chillers
-Geothermal

-Chiller type
-AHU vs FCU
-DX Pkg vs Split vs VRF

-Forced Air vs Radiant
-DOAS
-Energy Recovery

-VAV vs CAV
-Variable Primary CHW Pumps
-Demand Controlled Ventilation
-Economizer control

Detail Design

Design Development

Cycle 5 - Design Refinement

Building Envelope design refinement

Lighting & Daylighting design refinement

HVAC design refinement

DWH design refinement

→ Refined design with reduced energy consumption & demand

-Building system options:
ICF/SIPs/precast
-Roof materials options
-Facade systems options

-Windows size & placement
-Skylights size & placement
-Shading options
-Glazing materials specs

-Equip. Configuration:
Size & Qty.
-CHW loop design options
-Air distribution & zoning options

-System:
Central vs Distributed
-Equipment:
Heat Pump vs Boiler
-Storage:
Storage tank vs Instant
-Energy:
Natural Gas vs Elec.
Solar vs Heat Recovery

Cycle 6 - Design Integration & Optimization

Design Integration → Design Optimization → Analysis results supporting Integrated & optimized design

BUILDING:
-Energy Recovery
-Condensate water harvesting

SITE:
-PV / energy storage
-Rain water harvesting
- Waste heat recovery, CHP, absorption chillers

Multi-Objective Optimization:
-CAPEX
-OPEX
-Emissions
-Comfort
-Daylight

Const. Doc.

Construction Documents

Cycle 7 - Pre-construction Design Change Modeling

Identify design alternatives for DC proposal → Energy modeling of DC alternatives → First cost & operating cost analysis → First cost and operating cost impact of Design Change proposal

Cycle 8 - As-Designed Energy Performance

Energy modeling of as-designed project → compare as-designed performance to goals → - Energy model of as-designed project
- Comparison with performance goals

Const. Doc.

Construction Documents

Cycle 9 - Change Orders

Develop a process to address Change Orders → Update energy model based on proposed Change Order → - Feedback on energy performance impact
- Updated energy model based on proposed Change Order

HAND-OVER

As-Built Documents

Cycle 10 - As-Built Energy Performance

Energy modelling of as-built project → compare as-built performance to goals → - Energy model of as-built project
- Comparison with performance goals

IN-OPERATION

Utility Bills

Cycle 11 - Post-Occupancy Energy Comparison

Compare As-Built Model projection to12 months energy bills → Propose Energy Saving Measures → - Comparison of As-Built Model projections to Actual Energy Consumption
- Potential Energy Saving Measures
- Feedback to future projects

LEGEND

Mandatory Requirement / Simulation Cycle

Optional Simulation Cycle

Project Phase

Example measures

Process

Outcome

Cycle 1: Simple Box Modeling

PURPOSE

Identify energy use breakdown

Evaluate energy use and demand characteristics that affect building conceptual design.

PROCESS

Create a Simple Box model based on building location and type (Use identical HVAC systems)
Conduct sensitivity analysis to changes in design variables:
a. Building geometry.
b. Window-to-wall ratio.
c. Orientation.
d. Building envelope and structure.

OUTCOME

Determine which characteristics affect performance the most.

Energy consumption breakdown by end-use

Peak heating and Cooling loads.

TIMING & APPLICABILITY

Early in Concept Design. Before deciding on geometry and orientation. Before or During Design Charrette.

Cycle 2: Conceptual Design Modeling

PURPOSE

Evaluate energy improvements relevant to building form and architecture.

PROCESS

Model variants of building form and architectural concepts.(Use identical HVAC)

Compare and evaluate improvement measures.

OUTCOME

Recommended passive design strategies for modeled concepts.

Recommend building architecture.

Energy consumption breakdown by end-use.

Peak heating and Cooling loads.

TIMING & APPLICABILITY

After completing Load Reduction Modeling. Before the end of the construction documents phase. After defining the design direction for: Building form, orientation, HVAC, water heating system and space program

Cycle 3: Load Reduction Modeling

PURPOSE

Evaluate performance considering load reduction strategies relative to the current proposed design.

PROCESS

Model and compare strategies that reduce heating and cooling loads based on current architectural concept (Orientation, form and geometry) (Use identical HVAC)

Applies for loads comprising at least 60% of the total annual energy use.

OUTCOME

Shortlist at least three peak load reduction strategies with the biggest impact on energy consumption and HVAC system sizing.

Energy consumption breakdown by end-use.

Peak heating and Cooling loads

TIMING & APPLICABILITY

Prior to end of Schematic Design. Prior to final selection of HVAC system type. Required for all projects..

Cycle 4: HVAC System Selection Modeling

PURPOSE

Estimate the annual energy and demand impacts of HVAC system options.

PROCESS

Building energy simulation to evaluate a minimum of two HVAC system concepts.

OUTCOME

Comparative analysis of potential HVAC design concepts.

Annual energy and demand impacts of HVAC system concepts

Recommended HVAC system concept

TIMING & APPLICABILITY

After Load Reduction modeling. Before HVAC system selection.

Cycle 5: Design Refinement

PURPOSE

Use energy models to evaluate building systems, confirm current design directions, and support further development of the building design.

PROCESS

Use energy modeling to develop and refine the design of at least one building system:
1. HVAC systems.
2. Lighting systems.
3. Building Envelope.
4. Service water heating system.
5. Process and plug loads.

OUTCOME

Energy modeling results supporting design development and refinement

TIMING & APPLICABILITY

During Concept Design. Before finalizing building form and architecture.
Applies to buildings with process loads ≤ 75% of overall energy

Cycle 6: Design Integration and Optimization

PURPOSE

Integrate building systems through an optimization process to assist in meeting the project's energy performance goals.
Use energy modeling to study the complex interactions of multiple variables.

PROCESS

Conduct an optimization analysis using:
1. Optimization Objectives: One or more, relevant to the performance goals.
2. Optimization Variables: At least two design variables that can potentially be optimized.
3. Optimization Constraints: test range for each analyzed design variable based on Identified constraints. (test range, max and min limits)

OUTCOME

Facilitate the integration and optimization of building systems design to help meet performance goals.

TIMING & APPLICABILITY

Before the end of the Construction Documents phase.

Cycle 7: Preconstruction Design Change Modeling

PURPOSE

Use energy modeling to evaluate impact of Design Change proposal on performance goals

PROCESS

Identify design alternatives arising form at least one Design Change proposal
Use energy modeling to evaluate impact on performance goals

OUTCOME

First cost and operating cost impact of Design Change proposal.

TIMING & APPLICABILITY

Before the end of the Construction Documents phase. First cost estimates must be available.

Cycle 8: As-Designed Energy Performance

PURPOSE

Evaluate as-designed energy performance relative to project performance goals.

PROCESS

Develop a building energy model to represent the As-Designed project.

OUTCOME

Comparison of As-Designed performance to project performance goals.

TIMING & APPLICABILITY

After completion of Construction Documents.

Cycle 9: Change Orders

PURPOSE

Analyze the impact of Change Orders on energy performance.

PROCESS

Develop a process to address Change Orders: Roles and responsibilities and Timeframes.
Update energy model based on at least one proposed Change Order.

OUTCOME

Updated energy model based on a proposed Change Order.

Feedback on energy performance impact.

TIMING & APPLICABILITY

Prior to Constuction. Applies to Change Orders that negatively impact performance goals

Cycle 10: As-Built Energy Performance

PURPOSE	PROCESS	OUTCOME
Evaluate as-built energy performance relative to project performance goals.	Develop an energy model to represent the as-built physical building asset. Compare as-built performance to project goals. Use “As-Designed” schedules unless new information is available.	Energy model of As-Built project. Comparison with performance goals

TIMING & APPLICABILITY

After Construction Completion. After final As-Built Drawings submittals.

Cycle 11: Post-Occupancy Energy Comparison

PURPOSE	PROCESS	OUTCOME
Inform future energy model assumptions and potentially identify operational energy savings opportunities.	Compare modeled energy performance from the last design- or construction-phase energy model to the actual measured energy use from utility bills If available, use actual rather than “typical” weather data. Optional: Regression analysis to calculate error metrics (The predictions relative to actual)	Evaluation of Post-Occupancy energy performance relative to performance predicted by the last design or construction phase energy model Potential energy savings measures Feedback to future projects

TIMING & APPLICABILITY

Post- Occupancy. 12 months at least.