U.S. Dept. of Energy Challenge Home Student Design Competition Guide to Project Preparation and Submittal

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AUGUST 2013

Revision 1

NOVEMBER 2013

Revision 2

DECEMBER 2013

5068-130_12202013

FOREWORD

This December Edition Guide to the DOE Challenge Home Student Design Competition is a comprehensive overview of the framework, timeline, design parameters and judging criteria and includes revisions from the August 2013 version noted in underlined or strikeout red text. This Guide provides links to documents and other resources that will be needed by the Teams. This Foreword summarizes key steps from registration to the awards event.

- ❑ Read this Guide and consider forming a team. A team must have at least 3 students and a faculty advisor.
- ❑ Register your Team when you are ready or signup for updates if you are interested by not ready to register.
- ❑ When registration is complete Team members will be contacted via email so they can access additional resources.
- ❑ All team members with a construction / engineering / architecture / design major must complete the EEBA Houses That Work online coursework. Team members majoring in business or related fields do not need to complete this coursework. This coursework is provided at no cost to every team member.
- ❑ Select a location for your project and house design
- ❑ Determine an approach to the house design (stock plan, new plan design, industry partner plan).
- ❑ Develop the financial constraints for the project and house construction.
- ❑ Using the reference materials and a whole-house integrated design methodology, develop a new house design that meet the efficiency and performance goals set by the team and satisfying the DOE Challenge Home requirements.
- ❑ Evaluate the house design per the Building Science principals outlined by your advisors/instructors and in this Guide using the appropriate design tools.
- ❑ Prepare the materials outlined in this Guide for Judging Sections A through K.
- ❑ Please review submission for NAHB Student Competition available at the link below as representative for the style of submission expected, NOT content: https://www.dropbox.com/s/qrr1vtayvj1aq9u/1st%20Place%204YR_Michigan%20State.pdf
- ❑ Submit all materials for judging by the deadline.
- ❑ Good Luck!

Questions on the Competition framework contact Home Innovation Research Labs.

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Vision Statement

This is an exciting time – a time when Zero Net Energy Ready Homes have become readily achievable and cost effective. By definition, these high-performance homes are so energy efficient, renewable power can offset most or all the annual energy consumption. As part of its Building America Program, the U.S. Department of Energy (DOE) is engaging college students across the United States to participate in the ***DOE Challenge Home Student Design Competition*** and become part of this leadership movement to achieve truly sustainable homes. This competition will provide the next generation of architects, engineers, construction managers, and entrepreneurs with skills and experience to start careers in clean energy and generate creative solutions to real-world problems.

Through the Challenge Home, DOE seeks innovative solutions for high-performance homes that could be implemented by the home building industry, thereby serving as "models for success." The core of the competition's judging criteria is based on demonstrated competency applying Building America's research findings, best practice solutions, and principles of building science. Teams will be judged on their design/construction document packages, project plans, and reports on required analyses. These submissions are intended to demonstrate the teams' knowledge and skills to design, analyze, and plan the construction of quality, high-performance homes that meet or exceed the DOE Challenge Home requirements.

Benefits of Participation

Through this competition, students will have the opportunity to provide creative solutions to real-world issues and barriers to innovation associated with our nation's housing industry. Finalist teams will be invited to attend the competition's judging day and present their proposals to a panel of practitioner judges. The winning team proposals will be recognized at a national conference and made available on the ***DOE Challenge Home Student Design Competition*** website. A wide array of construction trade publications and mainstream media are expected to cover the event and the winners—that kind of national exposure can provide career-launching opportunities for the students who participate. Universities can also gain notoriety as leading institutions that are producing job-ready young professionals with cutting-edge skills relevant to a rapidly evolving housing industry. Participating builders will gain national and local recognition and have meaningful interactions with knowledgeable and skilled future design and construction professionals.

Competition Framework

The competition will be held on a two-year cycle that alternates with the Solar Decathlon. The Decathlon's off year in the United States serves as the award-year for the Challenge Home competition.

Each team must be sponsored by a collegiate institution, be comprised of at least three students and a faculty advisor, and have a designated team lead. Student teams are encouraged to be multidisciplinary in nature and have industry advisors, such as a local home builder or architect, to help inform their decision-making process.

The competition is based upon a real-world scenario where a builder needs to update an existing product line (house plan) to a high-performance house design or is developing a new high performance home product line. Specific building lot and neighborhood characteristics will be provided along with relevant homebuyer demographic profiles for context and other architectural integration considerations. The student teams may either redesign the existing floor plan or create a new house design that satisfies the project requirements. The mandatory design target is the DOE Challenge Home and the design solution(s) **must be documented** to meet the following criteria:

- They must be cost-effective from the buyer's perspective – this means monthly mortgage payment, insurance, utility, maintenance, and taxes should be cost neutral or cash-flow-positive as compared to the calculated affordability based on the Median Family Income.
- They must achieve at least the DOE Challenge Home energy performance level.
- Teams must demonstrate effective integration of building science principles and best practice guidelines in the submission.
- Architectural and engineering team members must complete a required six-course building science curriculum, "Houses that Work," presented online by EEBA or equivalent course offered at their school. In all cases, students must successfully pass the "Houses that Work" online test administered by EEBA.

Timeline

- **Registration Deadline:** December 16, 2013
- **Fall Semester 2013/Spring Semester 2014:** Students Develop Design for Submittal
- **Mid-Spring Semester 2014:** Submittals Due March 30, 2014
- **Spring Semester 2014:** Awards Presented

Student Design Challenge Project Design Parameters

Student teams have two pathways to satisfy the competition design parameters. Teams can meet the criteria outlined in Tables 1 and 2 below OR teams can follow the design criteria for a project that is intended to be built, including site location and lot details. Regardless of what path is selected, all teams must meet the Construction Costs and Financial Parameters set out in Table 3 below.

Student teams have the option of either selecting an off-the-shelf set of house plans[1] that may be redesigned to a Challenge Home design or develop an entirely new Challenge Home house design. Either

[1] Donald A. Gardner Architects, Inc. has graciously agreed to provide home plans for the Student Competition. The plans remain the intellectual property of Donald A. Gardner Architects, Inc. Students may use the plans only for the DOE Student Competition. The plans can't be used for any other purpose, nor may they be provided to any other parties for any purpose.

approach must meet the real-world design constraints defined in Tables 1, 2, and 3. House designs are limited to single-family detached or attached homes and with the following criteria:

- Stock house plans or a unique house design based on the parameters outlined in Table 1.
- House lot and other location parameters outlined in Table 2.
- Reference cost and financial parameters outlined in Table 3.
- For attached home designs, all of the homes must meet the requirements of the Competition.

The challenge is to develop a house design that meets the minimum house characteristics and that meets or exceeds the DOE Challenge Home requirements for energy efficiency while remaining affordable based on the stipulated financial constraints.

A minimal set of design constraints for the Student Competition have been developed that represent typical and affordable characteristics of new homes. The specific architectural details for the home, such as room sizes, window areas, and foundation are left to the Teams. In lieu of developing a new architectural design, teams may use the plan set that is provided after the team registers for the competition. Teams may modify any aspect of the stock plans as long as the design constraints in Table 1 are satisfied.

Table 1. General House Characteristics

Minimum House Design Characteristics		Notes
Bedrooms	3	The minimum size per the IRC is 70 square feet
Bathrooms	2.5	Any combination of bathroom fixtures is acceptable
Utility room	1	Minimum size to house heating, cooling, ventilation, and water heating equipment (if applicable). Basement, garage, attic, or crawlspace areas are acceptable if included in the thermal design of the home.
Garage/Carport	2-car	Attached or detached acceptable. If carport, a storage/utility shed of at least 120 sf must be provided.
Laundry area	1	Any location is acceptable, space must be sufficient to house full size equipment side-by-side.
Non-specified Design Features	• House size (Challenge Home energy analysis is adjusted based on house size) • Foundation type(s) • Window area and orientation • Number of stories • Relative room location	

The specific location for the house design is left to the teams. Any U.S. location is acceptable however the lot parameters outlined in Table 2 constrain the design to populated areas as would be typical of developments.

Table 2. House Location Parameters

House Location Parameters	
Lot size	75 feet wide by 120 feet deep
Minimum set back	30 feet
Side setback	20 feet combined minimum, 5 foot minimum to property line
House orientation (Front)	Climate Zones 1-3: Southwest Climate Zones 4-8: Northeast
Adjacent homes	Each side
Adjacent Neighbors	House designs typical of the selected area
Occupants	2 Adults, 2 children, 1 dog
Note: The front of the house is assumed to face road frontage.	

One important and very practical design constraint is cost. While many of the house design characteristics can be creatively modified for a new generation of high performance housing, the affordability of the new design must be clearly understood and adhered. The financial constraints outlined in Table 3 are meant to provide context for selection of materials, systems, house size, and even labor costs associated with unique design features.

Table 3. Construction Costs and Financial Parameters

Construction Costs and Financial Parameters	
Median Family Income (MFI)	For your selected project location, either use the HUD FY2013 Median Family Income (MFI) data set[1] to determine the household income or use one of the standard income levels of $50,000, $75,000, or $100,000.
Home Ownership Affordability	For the purposes of this Challenge Design, the home ownership affordability should not exceed 38% of the household income. Home ownership affordability includes principal (P), interest (I), property taxes (T), home and mortgage insurance (I), and utilities (U) [energy and water].
Standardized Home Ownership Cost Estimates	Use the following estimates below to calculate the maximum house sales price based on a maximum of 38% of MFI for PITIU
Utility Costs	Use Local utility costs. May be defined for a specific location based on actual utility rates or use representative resource[2].
Financing (Principal and Interest)	4.5%, 30-year fixed rate
Property Tax	3.0% of MFI or use local data resource
Insurance[3]	$780, or use local data resource
Down Payment	20% of MFI
Mortgage Insurance	2.5% of MFI
Monthly Household Debt	0.5% of MFI
Construction Cost Estimates	
Non-construction costs	Calculate the non-construction costs as a percentage of the sales price using 40.6% times the sales price. The remaining cost is associated with the construction of the home[4].
Direct Construction Cost Reference Comparison	For a breakdown of construction costs by major features as a percent of house value, refer to the NAHB study "New Construction Cost Breakdown"[4] or other estimation tools[5].

[1] http://www.huduser.org/portal/datasets/il/il13/index_mfi.html. Use the rounded MFI estimate.
[2] For example for electric rates, http://en.openei.org/wiki/Gateway:Utilities, or use Energy Information Administration data
[3] See http://www.nahb.org/generic.aspx?sectionID=734&genericContentID=193629&channelID=311 for one resource of home ownership costs
[4] http://www.nahb.org/generic.aspx?genericContentID=169974
[5] for example http://costtobuild.net/index.html or http://rsmeansonline.com/

Judging Criteria

The Challenge Home competition's judging criteria is based upon demonstrated competency applying Building America's research findings, best practice solutions, and principles of building science. The student teams will be judged on their submissions including their design/technical documentation, project plans, and reports on required analyses. These submissions should demonstrate the teams' ability to design, analyze, and plan for the construction of quality, high-performance homes that meet or exceed the DOE Challenge Home requirements.

The judges will evaluate how well teams meet the overall goals of the competition and complete the requirements of the submission package. Metrics used by the judges will include:

1. How well the competition home incorporates the required base house features and integrates proven high-performance innovations with regionally appropriate design solutions.

2. The degree to which the competition home is determined to be cost-effective, from the buyer's perspective, providing a cost-neutral analysis to include monthly mortgage payment, insurance, utility, maintenance, and taxes as compared to the existing house design.

3. Documentation of the analysis used to estimate achievement of a DOE Challenge Home energy-performance level or better.

4. Documentation to demonstrate the building science principles and best practice guidelines used in the submission.

5. Successful completion of the knowledge verification coursework—a six-course building science curriculum, "Houses that Work," presented online by EEBA.

Judging Evaluation Subject Areas and Point Rating

The judges will score each section on a scale of 0 to 5 points with the higher point level indicating a more complete submission. Each section is weighted by a maximum point value. The judges' point scale is then converted to a percentage and applied to the weighted point level. Each section total is summed into a final project score. The extra credit section is a straight point total that can be added directly to the weighted score.

Section	Subject Area	Maximum Point Value	Judge Rating Scale	Percent Weighting*	Subject Area Points
A	Team Qualifications		Complete Documentation		
B	Design Goals	20	0 - 5	0 - 100%	0 - 20
C	Financial Analysis	12	0 - 5	0 - 100%	0 - 12
D	Envelope Durability	16	0 - 5	0 - 100%	0 - 16
E	IAQ Evaluation	16	0 - 5	0 - 100%	0 - 16
F	Space Conditioning	16	0 - 5	0 - 100%	0 - 16
G	Domestic Hot Water	5	0 - 5	0 - 100%	0 – 5
H	Lighting & Appliances	5	0 - 5	0 - 100%	0 - 5
I	Zero Net Energy Use	5	0 - 5	0 - 100%	0 - 5
J	Construction Documents	5	0 - 5	0 - 100%	0 - 5
		Weighted Total for Required Subject Areas			**0 - 100**
K	Extra Credit	15	0 - 15		0 - 15
				Total Project Points	**0 - 115**

*Percent weighting calculated as a percent based on the Judge Scale i.e., a Judge Rating of 3 = 60% weighting

Example Team Rating

Section	Subject Area	Maximum Point Value	Judge Rating Scale	Percent Weighting*	Subject Area Points
A	Team Qualifications		Complete Documentation		
B	Redesign Goals	20	3.5	70%	14.0
C	Financial Analysis	12	3.0	60%	7.2
D	Envelope Durability	16	4.5	90%	14.4
E	IAQ Evaluation	16	3.0	60%	9.6
F	Space Conditioning	16	4.0	80%	12.8
G	Domestic Hot Water	5	2.0	40%	2.0
H	Lighting & Appliances	5	2.5	50%	2.5
I	Zero Net Energy Use	5	4.0	80%	4.0
J	Construction Documents	5	3.0	60%	3.0
		Weighted Total for Required Subject Areas			**69.5**
K	Extra Credit	15	10.0	-	10.0
				Total Weighted Points	**79.5**

*Percent weighting calculated as a percent based on the Judge Scale i.e., a Judge Rating of 3 = 60% weighting

Specific Submission Detail for Each Subject Area

A. Team Qualifications:

Describe the team qualifications, relevant education, and training to meet project goals for each team member, including any industry partners. Identify applicable coursework, projects, training, and experience that contribute to the design of a high-performance home meeting ENERGY STAR and DOE Challenge Home requirements. Outline the sponsoring institution(s) qualifications particularly in regards to Building Science education and the design of high performance homes.

Successfully complete EEBA's "Houses that Work" building science curriculum. Completion of the course work includes passing the test associated with each course. Student Competition Teams who pass all tests, and complete a student feedback evaluation, will be eligible to receive an Advanced Green Builder Certificate.

Required Submittal Items Checklist:

- ❑ Team Profile and Qualifications
- ❑ Academic Institution Profile with particular focus on Building Science
- ❑ Evidence of passing grade for the EEBA *Houses That Work* modules for all team architectural and engineering students. The Faculty Advisor should affirm in writing that all of the construction-major students have satisfied EEBA coursework.

Supporting Resources:
http://www1.eere.energy.gov/buildings/residential/ba_science_education.html
http://buildingscienceeducation.net/
http://greenbuildercollege.com/lev.php?L=11

B. Design and Construction Goals:

Describe the general approach to the house new or redesign from the standard design to the high-performance Challenge Home design. Include concepts such as architectural and performance goals to meet the occupant characteristics. Provide an overview of how a building-systems approach informs the proposed design to meet ENERGY STAR and DOE Challenge Home goals.

~~Demonstrate that the house design layout is no larger than the DOE Challenge Home and Energy Star 'Benchmark Home Size' but satisfies the builder requirements for the house characteristics and family needs.~~

Perform and document the Home Energy Rating System (HERS) rating whole-house annual energy consumption simulations, including the final plan-based HERS Index Score with and without renewables and projected annual energy consumption to meet the DOE Challenge Home HERS Index maximum.

Describe the integrated design process and how the Challenge Home Quality Management Provisions (QM #2) may be incorporated into the high performance home design process and documentation.

Required Submittal Items Checklist:

- ❑ Site Plan including solar orientation
- ❑ Floor Plans and Elevations
- ❑ Rendering, including interior design details
- ❑ HERS Rating and Report
- ❑ Overview of the Integrated Design Process

Supporting Resources:
http://www1.eere.energy.gov/buildings/residential/ch_index.html
http://www.ENERGY STAR.gov/index.cfm?c=new_homes.hm_index
http://www1.eere.energy.gov/buildings/residential/pdfs/doe_challenge_home_provisions032812.pdf
http://www.archenergy.com/products/remrate
http://www.energygauge.com/

C. Financial Analysis:

Provide an analysis of the Sales Price Breakdown, construction and operation costs, including an evaluation of maintenance requirements, combined with the assumed financing scenario to develop an overall cost of homeownership.

Analyze the cost implications of the increased construction costs for high-performance features versus the expected utility savings, including replacement costs for equipment over the length of the mortgage period. If applicable, federal, state, and local financial incentives for use of renewables or for energy efficiency upgrades may be included in the analysis.

Required Submittal Items Checklist:

- ❑ Construction Cost Estimate
- ❑ Annual Cash-Flow Analysis Using Specified Financial Parameters
- ❑ Sales Price Breakdown [See Footnote 4 in Table 3]
- ❑ Other

Supporting Resources:
http://beopt.nrel.gov/
http://virtual.clemson.edu/groups/psapublishing/Pages/FYD/EC676.pdf
http://www.dsireusa.org/

D. Envelope Durability:

Discuss the major mechanisms that affect envelope durability integrating building science concepts of air transport, moisture management, and thermal performance into a hygrothermal analysis based on average and specific environmental conditions.

Provide summary examples of construction details, material specifications, and discussion of the physical principles for air movement control based on air sealing and air barrier designs, thermal control using insulation systems and including analysis of thermal bridging, water, and moisture management including envelope features to shed precipitation, control of moisture movement through the wall system, and the potential for moisture problems with envelope materials (such as condensation).

Describe how the Challenge Home Quality Management Provisions (QM #1) may be incorporated into the high performance home documentation.

Required Submittal Items Checklist:

- ❑ Key Exterior Wall Sections
- ❑ Details for flashing, drainage plane, vapor management, thermal insulation and air sealing
- ❑ Other

Supporting Resources:
http://www1.eere.energy.gov/buildings/residential/ba_science_education.html
http://basc.pnnl.gov/building-science-explorer
https://www.ashrae.org/
http://www1.eere.energy.gov/buildings/residential/pdfs/doe_challenge_home_provisions032812.pdf
http://bse.pnnl.gov/

E. Indoor Air Quality (IAQ) Evaluation:

Discuss the overall approach to IAQ to meet general performance goals and satisfy specific field conditions.

Provide summary details of the indoor air quality environment, pollutant, and moisture control and the use of, and reliance on, mechanical systems to control the indoor environment. Provide references to ASHRAE and other standards and a specific evaluation of EPA's Indoor airPLUS design requirements as applied to the house redesign.

Required Submittal Items Checklist:

- ❑ Details for air filtration and ventilation system sizing, noise rating and controls
- ❑ EPA Indoor airPLUS Checklist
- ❑ Other

Example Resources:
http://epa.gov/indoorairplus/
http://www.wbdg.org/design/ieq.php
https://www.ashrae.org/standards-research--technology/special--project-activities
http://www.iaqscience.lbl.gov/

F. Space Conditioning:

Discuss the range of performance objectives for the mechanical systems targeted for space conditioning. Describe the systems approach relative to the structure and climate, including design principles for the mechanical system, the proposed operation and control, and the thermal conditioning for each type of space in the home.

Describe the design of the space conditioning operation goals, equipment selection and integration, operation and control, and evaluation of fuel selection options. Include system design using ACCA Manuals J, S, D, and T protocols or other industry practices such as ASHRAE or equipment manufacturer. Establish a set of commissioning (start-up) requirements referenced to manufacturer and trade protocols.

Provide a summary of the maintenance requirements defining roles for the occupants and trades including estimated annual costs.

Required Submittal Items Checklist:

- ❑ ACCA Manual J, S, D, and T Forms as applicable or other design documentation such as ASHRAE or manufacturer design methods
- ❑ HVAC Mechanical Plan indicating equipment location, distribution and controls for both space conditioning and ventilation systems including duct layout, sizing, and flow rates (separate or on plans)
- ❑ Homeowner Operation and Maintenance Checklist for mechanical systems
- ❑ Other

Supporting Resources:
http://www1.eere.energy.gov/library/default.aspx?page=2
http://bse.pnnl.gov/
https://www.acca.org/, https://www.acca.org/industry/system-design/speedsheets
https://www.ENERGY STAR.gov/index.cfm?c=heat_cool.pr_maintenance
https://www.ashrae.org/education--certification/self-directed-or-group-learning/fundamentals-of-air-system-design
http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/strategy_guide_air_distr.pdf
http://www.trane.com/Commercial/DNA/View.aspx?i=1239
http://www.smacna.org/downloads/orange.pdf

http://www.elitesoft.com/web/hvacr/duct60.html, http://www.wrightsoft.com/, http://www.designmaster.biz/products/hvac/LearnMore/Features/duct-layout.html

G. Domestic Hot Water:

Discuss the overall design principles of the hot water system. Include estimated loads, water heating equipment, supply piping, and layout.

Describe the hot water system design in detail including the supply flow rates and velocities to satisfy the estimated loads.

Optionally, provide a layout and specification for the hot water supply piping design and a detailed analysis of the hot water heating equipment including the effect on the indoor environment across seasons. Analyze the estimated wait time for hot water delivery and the system losses based on residual hot water left in the piping.

Demonstrate compliance with EPA's WaterSense specifications in design documentation.

Required Submittal Items Checklist:

- ❑ Plumbing Plan indicating equipment location, distribution, controls, and sizing design.
- ❑ Homeowner Operation and Maintenance Checklist for plumbing systems
- ❑ EPA WaterSense Checklist (indoors and hot water distribution)
- ❑ Other

Supporting Resources:

http://efficiency.lbl.gov/drupal.files/ees/Hot%20Water%20Draw%20Patterns%20in%20Single-Family%20Houses_Findings%20from%20Field%20Studies_LBNL-4830E.pdf
http://www.nrel.gov/docs/fy10osti/47685.pdf
http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/3_3b_BA_Innov_ModelSimRealDHW_011713.pdf
http://www.epa.gov/watersense/

H. Lighting and Appliances:

Discuss the overall approach to lighting and appliances, including example equipment and control scenarios.

Discuss the lighting analysis, including use of daylighting for specific rooms, high efficacy electric, and integrated renewable energy powered lighting systems. Discuss the potential for load monitoring and control of large appliances, and general miscellaneous electric loads. Describe the application of advanced technologies to automate control of energy use and provide energy information that can lead to reduced energy consumption.

Required Submittal Items Checklist:

- ❑ Hardwiring Light Plan including fixture locations and controls
- ❑ Light Design for work surfaces and general illumination levels
- ❑ Appliance Plan
- ❑ Load Management Plan
- ❑ Other

Supporting Resources:
http://www.resnet.us/professional/standards/lighting_appliance_misc
http://www.lrc.rpi.edu/programs/lightingTransformation/residentialLighting/
http://www.ENERGY STAR.gov/index.cfm?c=next_generation.ng_ee_light_app

I. Zero Net Energy Use:

Discuss the general house design modifications needed for incorporating renewable energy systems sufficient to achieve a zero net energy use from all non-renewable energy sources. Describe technology options appropriate for the location and climate, considering the neighborhood community as a potential for average reductions of non-renewable energy use applied to the individual homes.

Provide details of the EPA Renewable Energy Ready Home guidelines for solar water heating and solar photovoltaic systems. Demonstrate design details that comply with Renewable Energy Ready checklists for solar electric and solar thermal systems.

Provide a design and component analysis for active renewable energy systems to achieve a zero net energy use across all non-renewable energy sources used in the home. Include production and cost estimates including maintenance requirements, performance lifetime expectations, and financial analyses.

Required Submittal Items Checklist:

- ❑ Renewable Energy Plan
- ❑ EPA Renewable Energy Ready Home Checklist – Solar Electric and Thermal
- ❑ Other

Supporting Resources:
http://www.ENERGY STAR.gov/index.cfm?c=rerh.rerh_index
http://www.fsec.ucf.edu/en/research/buildings/zero_energy/
http://rredc.nrel.gov/solar/calculators/pvwatts/version1/

J. Construction Documentation

Provide a set of construction documents and working drawings that may be used for review with designers, trades, suppliers, fabricators, and purchasing.

Required Submittal Items Checklist:

- ❑ Site plan locating the house footprint, setbacks, and accessory structures and surfaces
- ❑ Floor plans defining room and dimensions
- ❑ Elevations
- ❑ Foundation, wall, roof, and ceiling details
- ❑ Structural details
- ❑ Window schedule and specifications
- ❑ Mechanical plan indicating all duct sizing and layout, equipment locations and specifications, control design and specification, and minimum installation requirements
- ❑ Plumbing plan showing fixture locations, piping system layout and design, equipment location and specifications, and minimum installation requirements

- ❑ Lighting plan showing outlet locations, fixture specifications, and all control systems
- ❑ Flashing details
- ❑ Air sealing details

K. Extra Credit:

The following details are not required for the basic submission, but may provide a more comprehensive opportunity to apply design and construction practices that meet the demands of durable, high-performance home designs.

Discuss the additional Quality Management systems that may be used by the builder or trade contractor to ensure repeatable and successful high-performance home designs. Incorporate Quality Management Provisions (QM #3).

Provide an assessment of opportunities for disaster resistance using documentation from the Institute for Business and Home Safety (IBHS) Fortified for Safer Living checklist. Where feasible, demonstrate where these design principles may be included in the house design and documentation.

Demonstrate the general green building design using categories from nationally-recognized third-party green building programs such as the ICC 700 2012 *National Green Building Standard™* (NGBS) or LEED for Homes (LEED-H), including aspects of land development, resource efficiency, energy efficiency, etc. Descriptions may include sustainable practices such as lean production processes, site recycling strategies, use of indigenous materials, sustainable product choices, and plans for reuse.

Required Submittal Items Checklist:

- ❑ Builder's Quality Management Plan
- ❑ Scope of Work – trade contractors
- ❑ Program Specific Checklists, e.g. IBHS Fortified Home
- ❑ Other

Supporting Resources:

http://www1.eere.energy.gov/buildings/residential/pdfs/doe_challenge_home_provisions032812.pdf
http://www.huduser.org/Publications/pdf/GettingLean.pdf
http://www.intechopen.com/books/integrated-waste-management-volume-i/waste-management-at-the-construction-site
http://www.toolbase.org/PDF/BestPractices/wastemngmnt_buildersguide.pdf
http://www.disastersafety.org/fortified/


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