AEC Sustainability Team

MASTER PLAN

AEC Sustainability Team Members: Diana Adzemovic, Ken Birringer, Michele Christensen, Tawanesha Jones-Williams, David Karle, or Deanna Mabry

PLAN OVERVIEW

The AEC Sustainability Master Plan is a comprehensive document which communicates the methodology Architecture Engineering and Construction (AEC) is employing to improve building design and construction sustainability at the University of Michigan.

The Master Plan divides sustainability into various categories, summarizing the tactics and policies that will be employed for each category.

The Plan is a living document, and will evolve as tasks are completed and policies are developed and refined. The category narrative defines the purpose of that category, describes in general terms the goals sought, and discusses the tasks necessary before the AEC Sustainability Team (or "Team") can recommend specific policies and targets for that category. As tasks are completed, policies and procedures will replace the tasks originally described in a category.

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ENERGY AND WATER CONSERVATION

The University of Michigan has a long history of implementing energy conservation measures in building designs. Previously, the University mandated all projects in excess of $10M construction cost be designed to outperform the American Association of heating, Refrigeration and Air Conditioning Engineers (ASHRAE) 90.1-2007 Energy Code by reducing energy costs by 30% compared to projects designed to only comply with the standard's baseline requirements. This initiative was called ASHRAE +30. The methodology used to demonstrate designs achieve the 30% energy savings matches those recommended by ASHRAE and required by LEED®. Major projects that have already met this goal include North Quad, Law School Academic Building, and Couzens Hall.

AEC Design Guideline 3.2 Energy and Water Conservation (DG 3.2) specifies global requirements for energy conservation for project designs (individual Design Guidelines often include more specific requirements). In addition to the requirements stated above, it dictates that certain *mandatory* ECMs be done on all projects, and that certain ECMs *be evaluated* for all projects. If an evaluated ECM meets the financial requirements indicated in DG 3.2, it must be employed on that project. DG 3.2 also specifies certain mandatory water conservation features (e.g. dual flush toilets) and sets a required water conservation goal for projects. Detailed reports regarding ECMs and water conservation are required, as well as an Energy Impact Statement for large projects. DG 3.2 is under continuous maintenance and will be updated as new versions of ASHRAE 90.1 are promulgated.

Examples of energy and water conservation measures incorporated into U-M projects include the following:

- The 235,000 square foot U-M Life Science Institute was the first known lab building design in the U.S. to use a "house air" system to reduce vivarium energy consumption by delivering outside air directly to ventilated animal racks. The same design was subsequently utilized in the University's 472,000 square foot Biomedical Science Research Building.
- New lab buildings at U-M routinely incorporate lab exhaust energy recovery systems.
- When appropriate, renovated resident halls at U-M utilize dorm bathroom ventilation air-to-air heat recovery.

- Projects are required to utilize dual flush water closets, waterless or 1/8 gallon per flush urinals, and low flow lavatory faucets and shower heads, in new or renovated toilet rooms and bathrooms.
- Residential rooms typically incorporate a user activated stand-by mode setting for the heating and cooling systems in each dorm room.
- Reduced lab air change rates have been incorporated into new lab construction. Lab air change rate minimums are typically 6 air changes per hour versus previous air change rate minimums of 10-12 per hour.
- Occupancy sensors are utilized on projects to not only turn lights off during unoccupied periods, but to set space ventilation rates to a minimum.
- Daylighting controls are often utilized on projects such as Law School Academic Building and Michigan Memorial Phoenix Mechanical Laboratory Addition.
- Demand controlled ventilation is routinely used on U-M projects.
- Chilled beams are incorporated into U-M projects when appropriate to reduce airflow requirements. For example GG Brown Addition will incorporate the extensive use of chilled beams in lab spaces.
- U-M projects incorporate enhanced envelope inspections to ensure that materials and assemblies installed in the field are consistent with construction drawings, specifications, submittals and manufacturers' recommendations.
- All large U-M projects incorporate thermal scanning of the building envelope to ensure insulation, sealant, and air barrier integrity.
- U-M requires that numerous energy efficiency measures be incorporated into lab designs when appropriate, such as variable air volume hoods, fume hood zone presence sensors, improved ventilation air flow efficiency, and manifolded exhaust systems.
- All projects are required to evaluate increased levels of envelope insulation and window performance that is above that required by code, against financial criteria which takes into account the longevity of such improvements.
- Extensive centralization of chiller plants has increased energy efficiency by taking advantage of aggregated load diversification. This allows better matching of chiller efficiency to load. Plant centralization also provides a centralized free cooling source which individual buildings might otherwise not have available to them.

ECM Quality Control

It is imperative that ECMs accepted during the design phase of a project are verified as actually implemented by the construction phase of the project. While this might seem like common sense, normal construction QC and even Cx practices are typically not well structured to verify that ECMs were ultimately implemented during construction. For example, the normal construction QC process likely will not verify if the correct high performance glazing was installed in fenestration. DDC programming required for certain ECMs might not be implemented by the technicians doing the programming, and that lack of programming would typically be unnoticed by occupants as long as their space was comfortable. Further, it has been our experience that ECMs conceived by A/Es during early design phases are often inadvertently left out of the final design documents produced by that same A/E! The Team is convinced these problems are not unique to the University of Michigan. It is the intent of the Team to develop protocols to assure that every ECM identified for a particular project is verified as actually implemented by the time that project reaches Substantial Completion.

As part of ECM quality control, the Team has developed a Construction Phase Exterior Envelope Observation Checklist. This checklist will be completed at specified intervals to confirm that materials and assemblies installed in the field are consistent with construction drawings, specifications, submittals and manufacturers' recommendations.

Submetering

As the old adage goes, if you can't measure it, you can't improve it. The University of Michigan has a long history of utilizing advanced Direct Digital Controls (DDC) to monitor mechanical and electrical systems on campus. The DDC system currently monitors in excess of 100,000 points, is staffed 24/7 by a Building Automation Services (BAS) staff, and has corrective action plans in place to address problems detected by the DDC system. For example, reliable electronic magnetic flow meters which utilize no moving parts are used on many heating and cooling systems to measure energy use and to recognize system problems which often result in wasted energy if undetected. Energy conservation organizations have long recognized that the metering of energy systems is a powerful tool for understanding where energy is being used and if it is being used efficiently. LEED® and ASHRAE's Standard for the Design of High-Performance Green Buildings 189.1 both encourage the use of submetering for the same reason.

Even though significant submetering has been the norm on U-M projects for decades, aninitiative is being undertaken to review where additional metering is appropriate, to enhance our M&V efforts. This initiative will also require that designs specifically identify "out-limit" conditions for meters to assure appropriate actionable alarms are created in the DDC system. Results of this effort will be rolled into the U-M Design Guidelines so that design teams know exactly where additional submetering is required. Projects will be required to develop a project specific M&V plan (when appropriate) which will be integrated into the University's over-all M&V plan. Over time, this will result in an even more robust metering/monitoring system than the University already has, and result in improved energy efficiency. It will also allow better post construction evaluation of energy conservation measures and building energy use.

NEW SUSTAINABILITY TECHNOLOGIES

Sustainability Technologies

The Team is researching additional energy and sustainability technologies and products for incorporation into the U-M Design Guidelines. The Team's research considers such criteria as embodied energy analyses, percentages of post-consumer and pre-consumer recycled content, use of renewable resources, on-going maintenance requirements, payback period, life-cycle assessment, regional availability, VOC levels, and warranty periods.

Research topics may be influenced by the types of construction projects for which a need has already been identified. For instance, U-M has been planning to build a new data center. The Team is already in the process of researching sustainable technologies which would be suitable for this application. Some of the identified technologies may also benefit existing data centers, and could be proposed for those facilities as well. Other research underway includes solar/photovoltaics, enthalpy wheels, advanced laboratory controls, air barriers and insulation, high-albedo and green roofs, high-efficiency fume hoods, construction QC for building envelopes, fenestrations, lighting controls, energy efficient plumbing fixtures, new light sources, exterior lighting, irrigation techniques, and low VOC materials.

Future technologies to be investigated include, but are not limited to, radiant heating and cooling, geothermal energy, under floor air displacement, LED and induction lighting, and highly energy efficient transformers and motors. The Team also plans to broaden its efforts by expanding the areas of research to include furniture and site materials, water- and energy-saving appliances, re-use of grey water, and integrated design.

THE SUSTAINABLE PRODUCTS PORTFOLIO

AEC is continuously developing a Sustainable Products Portfolio (SPP). Examples of products that will be listed in the SPP are hard flooring and carpets, wall finishes, ceiling systems, wood products, plumbing products, and paints. The SPP will provide architects and engineers working on U-M projects with a menu of sustainable products that have been evaluated against U-M specific criteria.

AEC already utilizes a PML for projects as a basis of manufacturer selection for University projects. Criteria used for selection and evaluation for the PML include product quality and life span, value, vendor service, ease of maintenance, performance, and lead-times.

Starting with the criteria used for the PML, the Team will add sustainability screening criteria. Third party testing and standards (ANSI, BIFMA, ISO and NSF for example) will also be used as guides for identifying meaningful sustainable product criteria. More importantly, certain products will be identified for "real world" testing at the University of Michigan, and will only be added to the SPP if test results are deemed satisfactory.

The SPP will be a complementary resource to the PML for use by architects and engineers when specifying materials and products for U-M projects and will require ongoing maintenance and updates. However, rather than being manufacturer focused like the PML, it will be product focused, for example listing all floor products that U-M has determined meet U-M sustainability criteria. Although not all products included in the SPP will need to be incorporated into the PML, the criteria used by the portfolio will inform updates to the PML.

The SPP is a resource that project teams are encouraged to use to select sustainable products. The SPP is not an all-inclusive list of available sustainable products and technologies. It is not intended to limit competition or replace creative sustainable design solutions. For additional information, please see Design Guideline 3.3 Sustainable Products Portfolio (DG 3.3).

SITE SUSTAINABILITY

Site Sustainability is a broad topic that addresses specific local and regional environmental issues related to buildings, landscape, hardscape, and exterior building and site issues. Sustainable site practices at U-M include eliminating mowing in perimeter areas, utilizing Integrated Pest Management (IPM) techniques, removing invasive species from campus wood lots, employing alternative snow removal techniques, and administering a stormwater management and pollution prevention program.

In an effort to enhance existing sustainable site practices, design guidelines have been revised and developed to coordinate with existing regulations and to recommend site specific strategies and Best Management Practices (BMPs). The design guidelines include recommendations regarding limiting paving, utilizing porous paving materials, an enhanced storm water management program, and information to assist in the selection of sustainable site materials. Also, additional guidelines for landscaping will be established which will focus on drought tolerant vegetation, native and non-invasive species, and enhanced IPM techniques.

Other site sustainability considerations are noise pollution, air dispersion, light pollution, and heat island effect.

U-M's practice is to consider both noise and air quality effects, especially for projects where large mechanical equipment is installed exterior to buildings (particularly laboratory exhaust fans and cooling towers). AEC has implemented a goal that new equipment will not produce a detectable difference in sound level, as perceived by the human ear, on surrounding U-M and private property. Further, sound pressure levels shall not exceed City Of Ann Arbor Noise Guidelines. Acoustical consultants are engaged to make recommendations regarding equipment placement, stack heights, enhancements to equipment and acoustical screening measures.

AEC routinely employs air dispersion studies for buildings with a sizable exhaust component, and those equipped with cooling towers, boilers, emergency generators, or other emission sources. These studies are utilized to ensure that emissions from buildings are properly dispersed and diluted to preserve a safe environment, prevent odors, and meet Federal and State requirements. Both analytical and wind tunnel modeling are employed. This work includes using strategies to reduce emissions at their source.

Outdoor lighting is addressed on a project-by-project basis as well as in the context of an overall campus lighting plan. All AEC projects are required to comply with exterior lighting requirements defined in Design Guideline 6.3 Technical Sections-Electrical, 265600 Exterior Lighting and DG 3.2. U-M outdoor lighting is designed to produce light levels that enhance safety while minimizing over-lighting and glare, two major forms of light pollution. Addressing overall light pollution issues also necessitates that interior light fixtures, whose light output is visible outside the building, be selected to minimize light spillage in areas where it is not required by Code or needed for safety. A site lighting team led by AEC is currently researching appropriate methods for reducing light pollution, energy consumption, and maintenance costs. Once the outcome of these potential methods is established, the results will be incorporated into the appropriate Design Guidelines.

The Team also has investigated roofing strategies for mitigating heat island effect, a condition which occurs when dark surfaces and large amounts of hard surfaces increase local temperatures. The temperature increase can in turn increase cooling loads and energy consumption. The Team's research has determined that the use of white roofing may reduce heat island effect of the surrounding areas but, high albedo roofing may also cause higher energy consumption based on the University’s geographical location. High albedo roofs reduce cooling load in the summer but increase the heating load in the winter. Due to the Michigan climate many buildings experience more heating days than cooling days; therefore, cool roofs often use more energy. Also, cool roofs may pose condensation problems when warm interior air comes in contact with a roof surface with a temperature below the dewpoint. This may cause moisture to infiltrate roofing materials and possibly collect in insulation joints where a freeze-thaw cycle can generate expansion forces, reduce the R-value of insulation, and result in a loss of wind uplift resistance. U-M projects consider all factors associated with high-albedo roofing materials on a project-by-project basis.

EVALUATING SUSTAINABILITY MEASURES

Tangible Benefits

One of the prime responsibilities of U-M AEC is to be a good steward of the University's financial resources. All ECMs and many SMs related to building design can be evaluated against financial metrics appropriate to an organization. Financial metrics may not be the only criteria that should be evaluated, but when a decision can be weighed against a financial metric it is certainly proper and worthwhile to do so. Further, if an ECM or SM meets or exceeds the appropriate financial metric, the need for further justification generally stops.

The University of Michigan has developed financial metrics for ECMs; see DG 3.2. To avoid lengthy analysis during design, the financial metrics are based on simple payback criteria rather than Life Cycle Cost (LCC). These metrics work well for ECMs that have relatively short paybacks. The U-M recognizes that certain energy conservation measures, such as optimized building envelopes (extra thick insulation in walls, high performance windows, etc.) have paybacks in excess of typical financial metrics, but still bear consideration. Such ECMs have very long lives and a high level of "persistence", i.e. once the ECM is in place the energy savings are likely guaranteed for the life of the building with little or no maintenance required. For example, additional wall insulation is unlikely to wear out, requires no maintenance, and is not subject to being "undone" for some reason in the future. Therefore AEC has developed financial metrics that are appropriate for these types of ECMs. During this evaluation, simple payback, LCC, and other methods will be evaluated. The goal is to allow projects to rapidly evaluate multiple ECM opportunities.

The Team believes that an appropriately streamlined financial evaluation process encourages project teams to evaluate more ECMs specific to a particular project, which will propel projects toward achieving optimum energy efficiency levels. Similar financial metrics can be developed for SMs.

Intangible Benefits

Sustainable building standards such as LEED®, ASHRAE 189.1, and the IGCC are increasingly recognizing and incorporating intangible benefits related to sustainability. The majority of intangible benefits can be classified as improved indoor environmental quality, improved occupant controllability of systems, greater connectivity between indoor and outdoor environments, and increased availability of natural daylighting and ventilation. Intangible benefits also include the walkability of the project's surrounding environment, the initiation of sustainable education programs, and the incorporation of design aesthetics as well as views and visual relationship to the exterior environment.

Standard financial metrics cannot be applied directly to intangible benefits of sustainability. However, studies have connected improved indoor environmental quality benefits to personal health, worker productivity, and academic performance. In some cases, simple investments can be made during design and construction phases for a project to realize these benefits. At the same time, intangible benefits must be balanced against possible detrimental effects on other sustainable measures such as energy consumption. The Team is currently developing a methodology to allow the evaluation of intangible benefits in a systematic manner.

DESIGN GUIDELINES

Coordinate Compliance with the Energy Code

As noted in the Energy and Water Conservation section, U-M has adopted the latest version of ASHRAE 90.1 as its energy code. In order to realize the resulting energy savings from this code change as quickly as possible, the Team has given top priority to reviewing and updating all existing U-M DGs which are affected by ASHRAE 90.1. This activity has already been completed.

Revisions for Sustainability

The Team is continually updating the DGs to incorporate additional sustainability requirements beyond their current content, while maintaining their original intent. Existing DGs that require immediate modification or do not presently require extensive research will take priority.

The Team has already implemented several changes to DG 3.2 and 2.1 OPR and BOD (Owner's Project Requirements and Basis of Design) (DG 2.1). The Team is reviewing and incorporating applicable energy and water conservation measures from ASHRAE 189.1, IGCC, and other green building standards into the DGs. In addition, U-M has adopted LEED®-Silver certification requirements for all new construction projects and building additions in excess of $10M construction cost. DG 3.1 explains this policy and provides information on sustainability requirements, specifications, and additional resources for all U-M projects.

New design guidelines for air barriers, joint sealants, low-emitting paint and coating products, glazing, construction waste management tracking, lighting controls, laboratory fume hoods, enthalpy wheels, and others have been developed. In addition, the team is working on the development of design guidelines for exterior envelope design and construction waste management. However, this list is not exhaustive.

As major updates and revisions are made to the Design Guidelines, additional training for AEC staff will be considered and scheduled as appropriate.

Please also see sections **New Sustainability Technologies** and **The Sustainable Products Portfolio** for additional information including the criteria utilized to help inform the Team's decisions for creating new DGs.

OWNER'S REVIEW

An Owner's Review is a comprehensive examination of a project's design documents by U-M stakeholders to evaluate if the design meets the Owner's requirements. Quality design documents are vital for the sustainability of a building project. In recognition of this, AEC requires Architect/Engineers to submit their project design documents to U-M for an Owner's Review at the conclusion of the major phases of design (generally at the end of the SD, DD and CD phases).

AEC coordinates the Owner's Review by distributing the project's design documents to the Project Team and the Users for their review of the project's scope. The design documents are also distributed to other U-M departments as applicable for review of their areas of expertise. In addition, two construction experts within AEC perform plan reviews for issues including completeness, clarity and bid-ability of project scope, and constructability, maintainability and coordination between documents.

The Owner's review process is described in more detail in Design Guideline 2.3 U-M Owner's Review (DG 2.3). The Team has expanded the process to incorporate the review of additional sustainability issues including compliance with the energy and water conservation, and sustainability Design Guidelines, Master Specifications and the SPP.

AEC SUSTAINABILITY CHECKLIST

The Team has developed a sustainability checklist to ensure that sustainability opportunities are fully addressed during design and construction. The checklist assists designers, Design Managers, and Project Managers. As the Sustainability Master Plan is further developed and design guidelines are updated and created, the Team will update the corresponding steps in the checklist.

COMMISSIONING

Commissioning is a systematic quality assurance process to ensure a building project is designed to meet the needs of its Users, and is built, operated, and maintained as intended by its Project Team and its Users. U-M has long recognized the value of building commissioning. Thus a key component of AEC's sustainability plan is the requirement that all large or technically complex U-M building projects undergo a rigorous commissioning (Cx) process.

In a decade-long study sponsored by the U.S. Department of Energy (DOE) and published on July 21, 2009, Lawrence Berkeley National Laboratory analyzed the commissioning of 643 commercial building projects nation-wide. They concluded, "…commissioning is arguably the single-most cost-effective strategy for reducing energy, costs, and greenhouse gas emissions in buildings today." AEC agrees completely with the DOE. We believe building commissioning is vital to maximizing a building's performance and to minimizing its energy and water consumption.

U-M commissioned its first building in 1988 when the building commissioning process was still in its infancy. The results were so successful AEC established an independent building commissioning group in 1989. Our Cx process exceeds the commissioning industry's recommendations and standard practices. In general, new building and major building alteration projects undergo both design phase and construction phase commissioning. This process begins during the building's programming stage and continues through building occupancy.

Additionally, major U-M projects which are mechanically or electrically complex normally undergo an enhanced design phase commissioning process. Commissioning Authorities conduct comprehensive meetings and coordinate detailed reviews throughout every step of design to assure mechanical and electrical systems are optimized in terms of energy and water efficiency, sustainability, reliability, and maintainability. AEC has recognized that enhanced design phase commissioning is necessary on complex projects to assure the Owner’s project requirements are completely captured and implemented, maximizing project sustainability in the fullest sense of the word.

The design-phase and enhanced design phase commissioning procedures have already been updated to facilitate compliance with the new requirements in DG 3.2 to emphasize incorporation of new sustainable technologies, methods, and products. Construction-phase commissioning procedures will be updated to address architectural issues such as the building envelope. The overall Cx process has been expanded to offer additional services including enhanced commissioning and post-occupancy commissioning.

LEED® promotes enhanced commissioning as a means of reducing the negative impact a building can have on the environment by verifying the completed project is being operated and maintained as intended. LEED enhanced commissioning consists of multiple activities performed by an independent Commissioning Authority: reviewing the project's design, comparing the design to the OPR and BOD, reviewing the contractor submittals, developing a systems manual, verifying that Owner training has been completed, and reviewing the building's operation with Operations and Maintenance personnel and with building occupants (CxA post occupancy review).

AEC's commissioning process is described in more detail in Design Guideline 4.3 Commissioning (DG 4.3). In addition, U-M Master Specifications 019100 and 019110 document the Contractors' and Commissioning Authority’s contractual requirements.

CONSTRUCTION SUSTAINABILITY

Construction sustainability encompasses practices and products affecting both indoor and outdoor environmental quality. Incorporating sustainability measures into construction management can significantly reduce a building's overall impact on the environment. Therefore, development of and updates to construction guidelines focus on waste management, IAQ procedures, VOC reduction, and construction related energy conservation.

Construction waste management (CWM) is fundamental for sustainability because construction and demolition waste contributes as much as 40% to the solid waste stream. In recognition of the need to decrease construction waste, U-M has facilitated the development and implementation of CWM programs on several recent construction projects. In order to further improve construction and demolition waste practices, the Team has created a Construction Waste Tracking specification form to gather data on the quantity of construction waste produced on projects. Also, the team is currently working on the development of a new guideline which will specify how construction materials and debris will be identified prior to construction start and how they will be recycled or reused once identified. Our intent is to cover the most commonly encountered materials on our construction projects. Also, a training plan for contractors will be developed to help ensure these strategies are realized.

Post-construction and pre-occupancy IAQ controls include equipment and material protection, duct protection, VOC containment, and use of filtration media. Good building IAQ starts with a proper architectural and HVAC design, and is assured by proper building maintenance. However, poor construction methods and materials can negate the intent of a good design and have a detrimental effect on post-occupancy IAQ. U-M has already instituted rigorous protection measures to assure that water, dust, and other construction debris are kept out of duct and air handling systems. Ducts are required to be stored above the floor in clean dry locations and to be continuously protected (covered) during construction. Partially installed ducts must have open ends sealed when not actively being assembled. If the air handling system is used for temporary service during construction, duct openings and return grilles must be protected with filters of a quality equivalent to that used in the air handler pre-filter position (typically MERV 8 or higher), and air handlers must have a complete set of pre and final filters installed. During temporary operation, contractors must change filters at the manufacturer's recommended change-out pressure drops. Prior to final turn-over, all air handler filters must be replaced with new, clean filters. Typically, U-M's requirements exceed practices such as those recommended by LEED®.

To both protect construction workers and to ensure appropriate IAQ levels post-occupancy, the Team has established guidelines for the use of low VOC products. Some of these products are incidental or used on a temporary basis, and might not be thoroughly covered in the specifications. For example, solvent based duct sealants may be appropriate for certain periods of construction and inappropriate for others. Therefore, scheduling exceptions will be considered.

Current U-M construction safety requirements include several strategies which relate closely to sustainability. Examples of these include environmental health and safety, housekeeping, and non-smoking policies. Please reference Construction Safety Requirements for additional information.

Post construction practices such as building flush-out and/or air testing are recommended by some organizations such as USGBC®, to provide enhanced IAQ when the project space is first occupied. Air testing has been determined to be the preferred approach and is typically performed by U-M OSEH.

AEC's contracts with Construction Managers and Contractors require that construction temporary lighting and non-essential temporary power be turned off during non-construction hours. Temporary lighting must be shielded to prevent trespass onto public right-of-way and private property, and it must be controlled by timers or scheduled manual switching to turn off the lighting when it is not required. Temporary power must be controlled by manual switching as well so electric heaters and similar tools are turned off when they are not needed. Essential tools such as pumps are allowed to remain on.

Diesel exhaust mitigation measures on U-M construction sites require all diesel equipment, except delivery trucks, be fueled with biodiesel. Also, when onsite diesel equipment is utilized on the project site for more than ten workdays it is required to utilize exhaust after-treatment devices to reduce emission from diesel engines.

POST OCCUPANCY EVALUATION

Sustainable Design Measures

The Team realizes that sustainability efforts should not end simultaneously with construction completion. Therefore, assumptions regarding sustainable design measures will be validated for “real world” installations to ensure that the results equal the intent. Evaluative criteria for post-occupancy measurement will be developed into a checklist which will cover the performance, functionality, productivity, user-friendliness, and maintenance requirements of the implemented materials and systems. The Team also intends to conduct performance reviews of furniture systems, lighting systems, materials and products, acoustics, thermal comfort, and indoor air quality during the project's corrective period in order to address any installation or warranty issues. Feedback and results of the post-occupancy evaluation will be used to edit the content of the SPP and DGs as needed.

Formulating a complete post occupancy evaluation plan will be a long term endeavor. The Team will coordinate with departments such as U-M Interior Design Services (IDS), Plant Engineering (UPE), and Planet Blue in order to complete this task.

Energy Conservation Measures

As an extension of the +30 energy conservation initiative, a strategy will be developed to validate the energy and water savings predicted by ECMs and water conservation measures. This will utilize “real world” utility metering and other techniques to assess the effectiveness of these measures. Additionally, maintainability, reliability, and persistence will be assessed. AEC will collaborate with Plant Operations/Plant Engineering to develop this strategy and to incorporate lessons learned into future ECMs. Evaluation methods that will be considered include DDC monitoring, portable instruments, field surveys, occupancy surveys, and submetering.

GETTING THE WORD OUT

To Ourselves

The Team will lead efforts to disseminate knowledge within AEC regarding sustainability standards, resources and requirements.

As new Design Guidelines and criteria are established, additional educational sessions will be scheduled to help familiarize employees with updates. This will facilitate the proper implementation of the sustainability guidelines into projects.

To Our Clients, the U-M Community and the General Public

The University of Michigan's commitment to environmental stewardship has been an ongoing endeavor for many years. AEC has supported the implementation of sustainable design for new construction and renovations and notes on its website, "U-M strives for increased energy efficiency as the most effective way to reduce its carbon footprint and therefore concentrates its design effort on maximizing energy efficiencies." In an effort to help design teams achieve the sustainable measures required for projects, Design Guidelines such as DG 3.2 and DG 3.1 were created and have been in use for over 20 years. These guidelines, along with other existing and proposed design guidelines, will continue to be updated to reflect current standards and conditions.

It is a continuing goal of the Team to publicize AEC's on-going sustainability efforts and its plans for further developments in this area. For designers, the DGs will continue to offer complete information regarding sustainability requirements for U-M buildings. The Sustainability Master Plan will be an additional information source for those in the U-M community and beyond who wish to find a comprehensive up-to-date description of the goals and activities of U-M Architecture, Engineering and Construction.

Further coordination outside of AEC will also be pursued with the Office of Campus Sustainability (OCS), informing student groups, Plant Operations, and the general U-M community about the features of AEC's Sustainability Plan.

News Flash

The AEC Sustainability Team News Flash is used to keep parties inside and outside of our organization abreast of sustainability activities occurring within AEC. The aim is to promote cross functional communication to assure AEC sustainability initiatives are leveraged across all the projects for which we are responsible. News Flash is published irregularly; all editions can be found here.

ABBREVIATIONS & ACRONYMS

A/E - Architect/Engineer

AEC - Architecture, Engineering & Construction

ANSI - American National Standards Institute

ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers

BAS - Building Automation Services

BIFMA - Business and Institutional Furniture Manufacturer's Association

BMPs - Best Management Practices

BOD - Basis of Design

CD - Construction Documents

CWM - construction waste management

Cx – commissioning

CxA - Commissioning Authority

DD - Design Development

DDC - Direct Digital Controls

DG(s) - Design Guideline(s)

ECM(s) - energy conservation measure(s)

IAQ - indoor air quality

IDS - Interior Design Services

IGCC - International Green Construction Code

IPM - Integrated Pest Management

ISO - International Organization of Standardization

LCC - Life Cycle Cost

LED - light-emitting diode

LEED - Leadership in Energy and Environmental Design

LEED AP - LEED Accredited Professional

M&E - mechanical and electrical

M&V - measurement and verification

MERV - Minimum Efficiency Reporting Value

NSF - NSF International

O&M - operations and maintenance

OCS - Office of Campus Sustainability

OPR - Owner's Project Requirements

OSEH - Occupational Safety and Environmental Health

PML - Preferred Manufacturers List

QC - quality control

SD - Schematic Design

SID- Special Instructions to Designers

SM(s) - sustainability measure(s)

SMP - Sustainable Materials Portfolio

U-M - University of Michigan

UPE - Utilities & Plant Engineering

USGBC - United States Green Building Council

VOC - volatile organic compounds