POE, EMS, and Building Energy Performance Certificate Implementation at USC, L.A

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ABSTRACT: The University of Southern California (Fig.1, 2) is a large consumer of resources. Annually, USC consumes an average of 155 million kWh of electricity, 4 million therms of natural gas, and 270 million gallons of water (http://www.usc.edu/fms/dept_energy_stats.html).
As a major research institution, it is the responsibility of USC to develop efficient ways in which these resources can be efficiently conserved and the university's environmental impact reduced.
To make these reductions truly measureable and sustainable, the USC School of Architecture (Fig. 3, 4) Environmental Management System (EMS) team is establishing an outreach pilot laboratory with its own main building and a test-bed for the University and its campuses in Los Angeles, providing applied research on resource conservation strategies. Furthermore the EMS research evaluates operation costs and green house gas reduction with post occupancy-evaluation methodologies and daily real time feedback with monitoring-data, sustainability training opportunities for staff, faculty, students, and the neighborhood and campus visitors interested in Sustainability (1)..
Keywords: energy, performance, measuring, auditing, indicators, ISO, LEED, POE, EMS

INTRODUCTION

EMS research members with graduate students and staff performed a gap analysis in 2007 under the leadership of the author of this submitted research paper. Since then the EMS team has been developing an overall EMS master plan using the ISO 14000 (2), and 9000 series. Energy Star (3), and LEED EB (4) as a customized USC baseline model, with real data input assistance from the USC Facilities Management Services (FMS).

Figure 1: USC Downtown campus map, School of Architecture is highlighted in red
Source: http://www.usc.edu/about/visit/upc/driving_directions/

The EMS research team established a customized environmental assessment method that provides USC with building plans and sections, U-value enclosure charts, HVAC diagrams, schedules and details for the data collection along with temperature and humidity sensoring throughout the semesters.

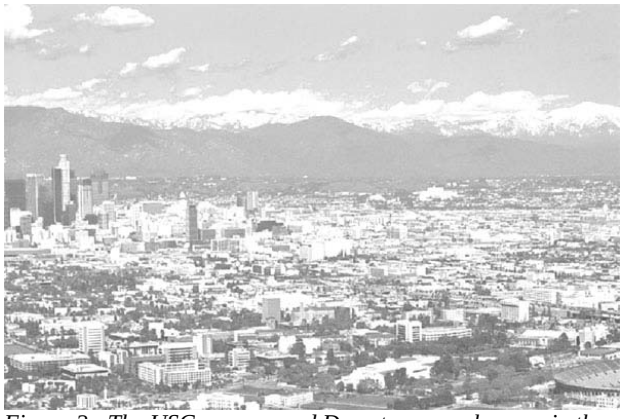

Figure 2: The USC campus and Downtown can be seen in the fore-ground.
http://ee.usc.edu/admission/graduate/why16044.htm

Address: 850 West 37th Street, Los Angeles, CA 90089
Latitude, Longitude & Altitude: 34.019°, -118.288°, 182ft
CA Climate Zone 9 (Source: California Energy Commission)

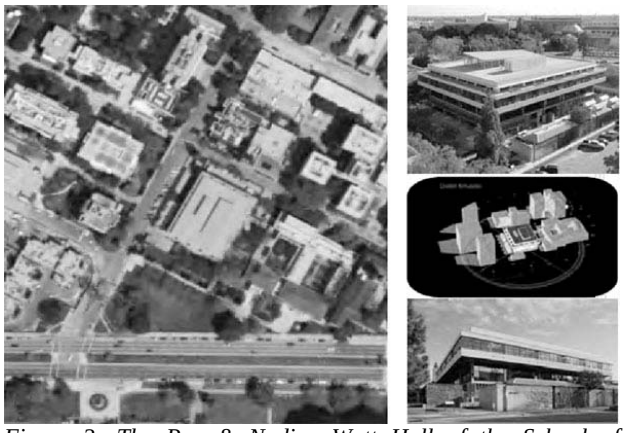

Figure 3: The Ray & Nadine Watt Hall of the School of Architec-ture, built in 1973 with the 3rd floor extension in 2004-2005, located on the southwest corner of the USC-Campus, southwest of downtown Los Angeles.

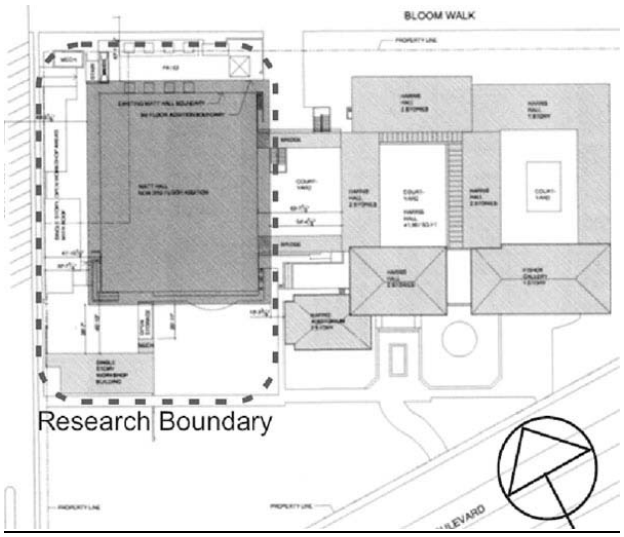

Figure 4: above. Research Boundary, Watt Hall, USC School of Architecture

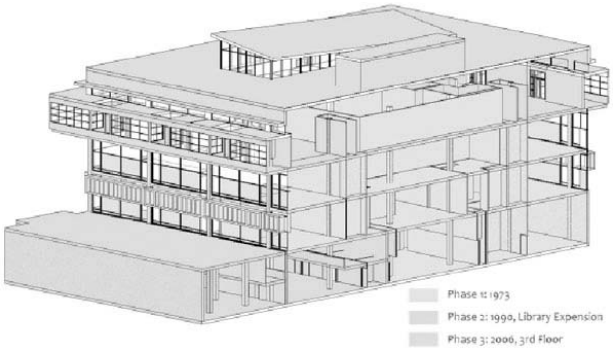

Figure 5: Northwest view of Watt Hall construction phases illustration, Shih-Hsin Lin, Revit Model of Watt Hall, 2008

Research Project Objective and Indicators The EMS Baseline Assessment and Resource Monitoring Implementation Feasibility Study identifies quantitative measures and applied research strategies that provide direct or indirect indicators of environmental performance improvements, conservation strategies and the implementation of renewable energy systems and materials related to the following 3 major steps as outlined below:

Develop Specific USC Environmental Indicators The first step is the development of a set of analysis indicators within a set boundary (Fig. 4, 5), measures the resource input and output, and the environmental impact of the School of Architecture. The concept is that data collection, energy simulation, calibration, data analysis, and the developed set of measures and strategy evaluation characterizes the environmental footprint of the School and the University in context (Fig. 6).

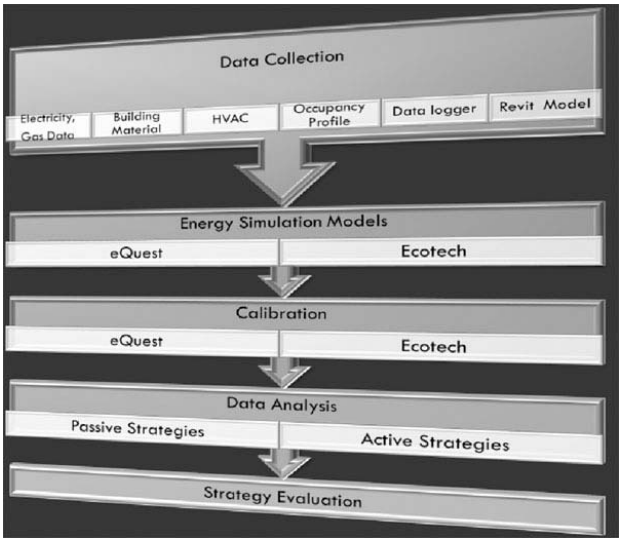

Figure 6: Methodology diagram, USC Building Science Thesis Graduate Student: Shih-Hsin Lin, Spring Semester 2008

Perform a preliminary partial baseline assessment for the School of Architecture The creation of a baseline assessment of easy to measure environmental characteristics, create a occupancy plan, and those zones in which there is data accessible. The assessment is focused on the School of Architecture Watt building and evaluates energy and water use, materials and food, greenhouse gas emissions and criteria pollutants among some others. (Fig. 7).

In order to analyze the energy consumption of Watt Hall an understanding of the spectrum of spaces and their uses within the building was needed. To provide this information a detailed room schedule was generated by Revit as listed in Appendix A and combined with on-site

documentation. Through this method, it was discovered that the primary space usage of Watt Hall could be divided into the following categories; classroom, corridor, gallery, library, kitchen, office, restroom, storage, & mechanical room, and studio, as shown in in Figure 7. In Watt Hall, studio space clearly occupies the dominant portion of the building.

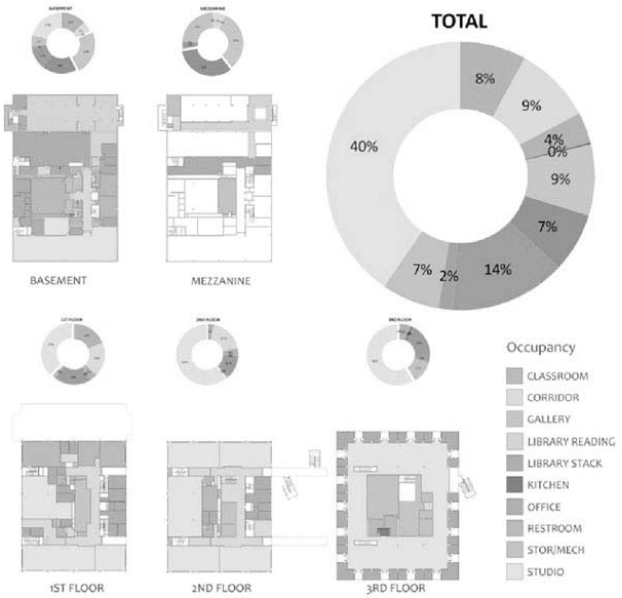

Figure 7: In Watt Hall, studio space clearly occupies the dominant portion of the building, Excerpt from EMS Zoning Analysis and Building Science Thesis Eve Shin-Li, Fall 2008

Assess the feasibility of a campus-wide environmental assessment and goals In this last step the School of Architecture EMS team addresses the costs, benefits of performing a campus-wide environmental assessment, and evaluates the opportunities that might exist to reduce the Universities environmental impact.

Applied Seven Indicator Research Methods The Environmental Management Systems (EMS) Method will be the primary tool in this applied research project to help the School of Architecture to identify strategies in order to;

(a) Minimize how their operations (processes, etc.) negatively affect the environment (i.e. causes adverse changes to air, water, or land);
(c) Continually monitor and improve in the above categories.

An assessment of the environmental performance of the School of Architecture in the day-to-day campus operations was first conducted. Specific assessment indicators of environmental performance still need to be developed in seven areas of the School of Architecture operations (Fig.8,9.):

3.1. OUTDOOR ENVIRONMENT MANAGEMENT:
3.2. PURCHASING AND PROCUREMENT SERVICE:
3.3. ENERGY MANAGEMENT:
3.4. INDOOR ENVRIRONMENTAL QUALITY:
3.5. WATER MANAGEMENT:
3.6. WASTE MANAGEMENT AND RECYCLING:
3.7. FACILITIES AND GREEN PRACTICES COMMITTEE COMMUNICATION EFFORTS

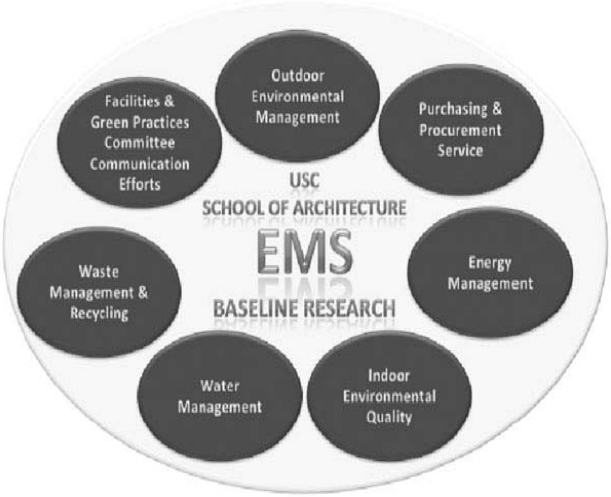

Figure 8: USC School of Architecture EMS Baseline Research frame work

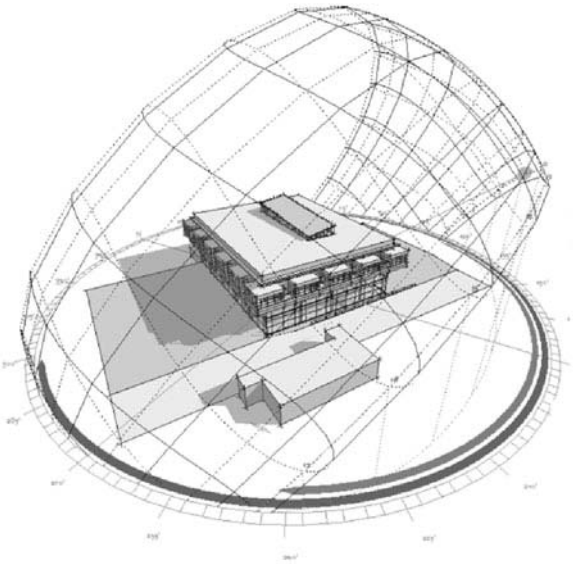

Figure 9: Ecotect Passive Strategies with Sun path and Shading Simulations conducted by the EMS team

First Post-Occupancy Monitoring and Building Performance Certificate Results The EMS research team has issued a Watt Hall Building Energy Performance Certificate for the fiscal year April 2006 to March 2008.

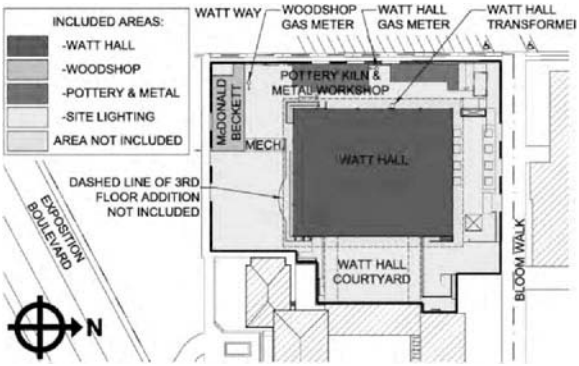

Figure 10: The research data collection boundary incorporates only Watt Hall, MacDonald Becket Woodshop (MCB) & SOFA Welding (See diagram above).

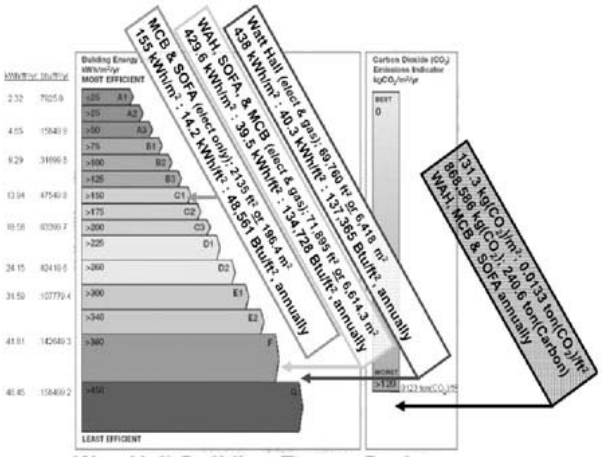

Figure 11: Building Energy Performance Certificate Analysis Method based on the European Energy Performance of Buildings Directive, by using L.A. Climate Data, and the Cal Arch EUI

The above data (Fig. 11, 12) of the Building Performance Certificate Methodology is based off of an as-built survey conducted by the Watt Hall EMS team and the utilities data collected in a given boundary (Fig. 10) by the USC School of Architecture from April 2005 - March 2008. The Building performance diagram is based on the European Building Energy Performance Analysis System for Educational Buildings (Universities) and shows that Watt Hall consumes 430 kWh/m2 annually of combined electricity and natural gas.

The CO2 emissions indicator shows that the building contributes to global warming, emitting 131.3 kg (CO2)/m2 or 218,313 kg carbon annually or 0.0135 ton (CO2)/ft2 or 240.6 tons of carbon annually.

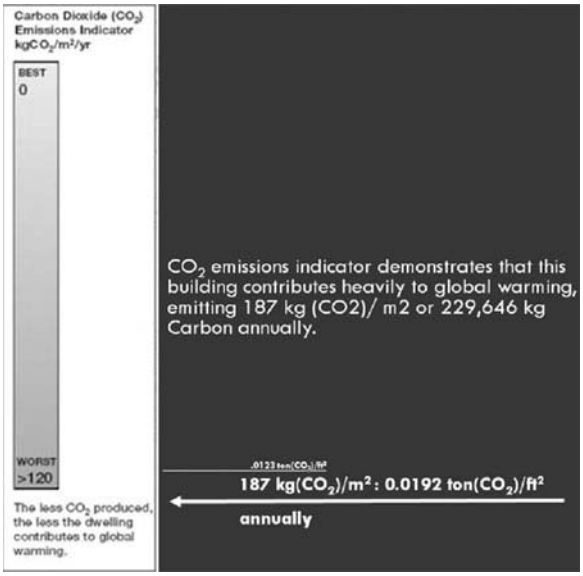

Figure 12: right. Building Energy Performance Certificate CO2 Analysis Method based on the European Energy Performance of Buildings Directive, by using L.A. Climate Data.

CONCLUSION

The implementation of the Environmental Management System and the Building Energy Performance Certification for the School of Architecture, and in long run for the University is created to be a tool that is updated yearly and used to expand environmentally progressive practices and applied research continually on the campus.

It provides critical means and feedback loop for universal environmental research and education for the students, staff, and faculty.

It helps to create leadership in defining how to be a sustainable and measureable community provides a model for the campus community and the surrounding local community at large.

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