



Sustainability: Un-definable Success in a Defined World 13 April 2017

E. Mitchell Swann P.E., LEED AP Principal MDCSystems[®] www.MDCSystems.com



What is...

 'Sustainable development: meeting the needs of the present without compromising the ability of future generations to meet their own needs.'

Reshaping the Built Environment Ecology, Ethics and Economics -Edited by Charles J. Kilbert Island Press, Washington, D. C. USA 1999 We are all faced with a series of great opportunities brilliantly disguised as insoluble problems.

John W. Gardner

Green Building Objectives

- greater efficiency
 - Energy
 - Resources
- lower life cycle cost
 - Operations
 - Maintenance
 - "total cost of ownership"
 - "cradle to cradle"
- healthier environment
 - IAQ
 - IEQ
 - waste management
 - increased productivity(?)
 - "enhanced wellness"
- better building performance



The Mission:

Provide Better Buildings

Green Buildings - Expectation and Intent



Sustainability requires...

...three components well put together



Performance mandated

LEED Rating	H	
Building Design + Construction	Entire building new construction or major renovations	
Interior Design + Construction	Interior fit-out of tenant spaces	BChydro 🖸
Operations + Maintenance	Entire existing buildings undergoing improvement with minor or no construction	powersr
Homes	New single-family homes, low-rise multi-family (1-3 stories), or mid-rise multi-family (4-6 stories)	
Neighborhood Design	New development or redevelopment projects with residential uses, nonresidential uses, or a mix.	

LIVING BUILDING CHALLENGE PETALS











owersmart

ANSI/ASHRAE/USGBC/IES Standard 189.1-2014 (Supersedes ANSI/ASHRAE/USGBC/IES Standard 189.1-2011)

Standard for the Design of **High-Performance Green Buildings**

Except Low-Rise **Residential Buildings**

A Compliance Option of the International Green Construction Code

approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the U.S. Green Build ministing Engineering Society of North America, and the American National Standards Institute.

uous maintananos by a Standing Standard Propert Committee (SDPC) for which the Standards Com-mented gragmen for regular publication of addends or revisions, including proceedures for time in on requests for druges to any gare of the standards. The charge adversarial form, instructions, ar electronic form from the ASHRAE website (www.advess.org), or in paper form from the ASHRAE website (www.advess.org), or in paper form from the ASHRAE website (www.advess.org), or in paper form from the ASHRAE website. trave has established a docu

The latest edition of an ADHRAE Standard may be purchased on the ADHRAE website linewashnas.org or from ADHRAE Cut stores Service, 1791 Talle Circle, NE, Adens, GA 2022b-2025, stephone: 454424-6805 (unrichweb), or sold from 1460-152 4723 for order in the Dahed Seaw of Canada, or weaks of event) and there are for represent permission, per somewahreas are

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HISCC



LEED Categories v4.0



- Certified 40 49
- Silver 50 59
- Gold 60 79
- Platinum 80+

Weighting the Impact Categories

Reverse contribution to global climate change (35%),

Enhance human health and well-being (20%),

Protect and restore water resources (15%),

Protect, enhance, and restore biodiversity and ecosystem services (10%),

Promote sustainable and regenerative natural resources cycles (10%),

Build a greener economy (5%)





LEED v4.0 "Raise the bar"

"Increased technical rigor" "integrative process"

- Location & Transportation category added
- Better defined "high performance" site design
 - rainwater management
 - heat island reduction
 - light pollution reduction
- Metering Energy & Water (heightened focus on water use!)
 - allocates 20% of all points to building energy efficiency
 - performance based approach to indoor environmental quality
- Encourages enhanced building commissioning
 - a credit for participating in demand response programs
- Materials & Resources lifecycle analysis approach
 - promote innovative reporting tools and programs
 - Source materials & manufacture transparency
- Support for local sourcing (extracted & manufactured products)



"Unpacking" LEED®

The Parts & The Players



* "Operations" is assumed to be 'by Owner'

In the long history of humankind, those who learned to collaborate and improvise most effectively have prevailed.

Charles Darwin.

Integrative\Integrated Design Practice

What does that mean to you?

The impact of time on "optionality"





What\How\Who\When (Why)\What\Who\How\When



a pilot LEED Dynamic Plaque on USGBC HQ, (which was certified Platinum in LEED for Commercial Interiors with a score of 94 in 2009) had a ""Dynamic Plaque "score of 77.

But there are risks. What if it doesn't get "gold"?

What if it doesn't work like expected?

Is that... Design? Construction? Operations? Or some combination of all 3?



So where does this take us?



The "performance" question Sustainability

performance over time

Does the owner have 'the right' to evaluate the building's performance 'over time'?

if so,

For how long???

What are the risks?

Certification

Delivery of a product that complies.

Performance

Execution of a project that performs.

Certification Failure

Design

- M & V Issues
- Incompatible equipment or materials

Construction

- Product substitutions
- Waste management issues
- Deficient documentation



Others???

Performance Failure

Design – Errors & Omissions

- (Oops! and/or "I forgot")
- Assumptions
- Predictions (models)
- Integration/Execution

Construction

"custom & practice"

- Workmanship
- Substitutions
- DeliveryOthers???

	Sustainability Topics		Building Spec		Specifi F	ific Measurement Parameters				Measurement Approach		ent h	Benchmark Approach					
Resource Documents and Programs	Economics/Financial	Environmental	Social	Design	Operations	First Cost	Life Cycle Cost	Life Cycle Assessment	Energy	Water	Other Enviromental	Productivity/satisfaction	Modeled/Estimated Data	Measured Actual Data	Anedotal Data	Comparable Building/Context	Model	Industry Standards
LEED Cost Study (GSA)																		
Costs and Financial Benefits of Green Buildings (California)																		
Business Case for Sustainable Design in Federal Facilities (FEMP)																		
Federal Sustainable Building Cost and Performance Metrics (FEMP)																		
eBIDS 🌁 (Carnegie Mellon University)																		
Workplace 20-20 (GSA)																		
Life Cycle Cost Analysis (NIST)																		
Costing Green (Davis Langdon Adamson)																		
Green Buildings, Org. Success, and Occ.Productivity, J Heerwagen																		
Human Factors of Sustainable Building Design, J Heerwagen																		
Occupant Indoor Environmental Quality Survey (CBE)																		
Post Occupancy Review of Buildings and their Engineering (PROBE)																		
Standardized Metrics and Procedures (NREL)																		
In Depth Case Studies of Energy Perform ance (NREL)																		
High Performance Buildings Database (DOE)																		
LEED for Existing Buildings (USGBC)																		
Green Building Challenge (ISBE)																		
Sustainability in Building Construction (ISO)																		
U.S. LCI inventory Database (DOE, NREL)																		
LCA into LEED Project (USGBC)																		
BEES (NIST)																		
In-Depth Case Studies																		
Navy Perform an ce Metrics																		

Establishing Performance Targets

Establishing 'reasonable' performance targets: 1 KW 12M 60W 52W 4.10 # 7,488

CHECK CALC FROM US DOE ANNUAL LIGHTING THATE LINK

...establish targets which accommodate some "misbehavior".

THEREFORE LIGHTING COSTS ABOUT \$. 75/SF PER YEAR

• ...learn what is "customary" based on System: VAV SingleDuct industry 'norms' 000 /VEAR



Summary of building heating and cooling performance.

1. General Summary

2 System: VAVSingleDuct

2.1 Heating Loads

2.2 Cooling Loads and Airfow Rates

3. System: Constant/Volum oF ked0.4

3.1 Heating Loads

3.2 Cooling Loads and Airflow Rates

1. General Summary

Model Data Project Ser "SemaleModeLmit" Model total floor area = 3500.3 m* Iddel total volume = 5869.4 m² Number of rooms = 62

Cooling Calculation Data Cooling results file: "Sample Model clo" Calculated at 13:43 on 12/Feb/07 Calc. Period: May - Set

System Heating Loads

Room he	ating load (kW)	Outdoor air prim	ary load (WV)	DHW (k)	N)	Plant load*		
Sensible	Hum id Fication	Mech vent	Aux vent	Heating demand	Plant load*	(kW)	(Willins ")	
90.09	21.10	0.00	0.00	0.00	0.00	144.25	45.15	

Heating Calculation Data

Calculated at 13:43 on 12/Feb/07

Heating results file:

"Sample Model htp"

Calc. Period: January

includes pipe & duct heat losses

Room Heating Plant Loads

Room Name temp. C)	Air	Conduction gain (KW)		Ventilat	ionsen	Sens	1		
	temp. (* C)	External	Internal	Mech vent (outdoor air)	Aux vent gain	Infitution	Natural	load (kW)	demand (kW)
10 Office	21.00	-0.60	0.04	-0.67	0.00	-0.09	0.00	1.23	0.00
11 Office	21.00	-1.04	-0.13	-0.70	0.00	-0.12	0.00	1.99	0.00
12 Office	21 00	-0.72	-0.08	-0.73	0.00	-0.12	0.00	1.05	0.00
13 Office	21.00	-0.53	-0.03	-0.63	0.00	-0.10	0.00	1.29	0.00
14 Office	21.00	-0.74	0.04	-0.77	0.00	-0.13	0.00	1.00	0.00
15 Stairwell	24.00	-0.67	-0.22	-0.34	0.00	-0.14	0.00	1.37	0.00
16 Office	21 00	-1.15	0.02	-0.69	0.00	-0.12	0.00	1.94	0.00
17 Office	21.00	-0.67	-0.10	-0.09	0.00	-0.12	0.00	1.58	0.00

Some Tools...

Performance...

- original input, assumptions & criteria.
 - Statement of criteria
 - Basis of design
 - include weather data 'basis'
 - with some acceptable deviation CITECT EMS SERVER

Documentation...

- Intent design
 - 'what did I say'...
- Expectation\Understanding operations
 - 'what did I mean'...
- Modeling, monitoring & optimization.



tility Meter Usage versus Production Energy per 15 Minutes, Sep 22, 2008

Tr1

Tr2

Load end feeders

ENERGY METERS

DG1

converte

DG2

DG3

Bus bar

Ethernet LAN

Monitoring and Measurement

- Audit & Verification
 - "notice"
 - opportunity to "cure"
 - 3rd Party Auditor



- Building Automation Systems
 - Data Monitoring, Retention and Trending
 - Use the BAS to facilitate audit & verification

Operations

How does design & construction enhance operations?

- Clarity of "intent"
- Properly manage "expectations"
- Guidelines and/or criteria for "proper" operation & use.

An Owner's Manual?

What would that look like?

In Operations...

More than traditional operating manuals.

- Training Programs
 - include methods, modes and schedules of operation;
 - maintenance guidelines.
 - integral to project execution
 - require sign-off
- Consider...
 - Video Recording of training
 - 'fault-tree' studies and analysis (up front!)

Green Operations Logic Model



Who owns the risk?

LEED Risks	Owner	Architect	Contractor	LEED AP
1) Lower Return on Investment	x			
2) Non-LEED Design	x	x		x
3) Non-LEED Construction	x	x	x	x
4) Missed Deadlines	x			x
5) Rescinded Certification	x	x	x	
6) Untested Materials & Results	x	x		
7) Higher Operating Expenses	x			
8) Material Delays	x	x	x	
9) Building Official Enforcement	x	x	x	
10) Post-certification Operations and Transfers	x			

Where is this all headed?



New Approaches are Required

- Project specific targets and set time period.
- 'Reasonable' goals relative to costs and 'complexity';
- Include criteria for operations & maintenance
 - facilitate 'best use';
- Performance measured over time;
- The evaluation of the impact of operations relative to design and relative to construction on the overall achievement of the sustainability targets will be critical to evaluating the long term performance.

Performance experienced controls 'value' perceived

What about contracts?

- Time
 - The duration of the project
 - but what about post-occupancy?

"Substantial Completion"

- at "Beneficial Occupancy"?
 - <...and Commissioning??>
 - (possibly validation or certification hospitals, pharma)

• 3rd Party Certification

- Code compliance
 - 'static' 'snapshot"
- Operations!!!???
 - Your Mileage May Vary!!!

What becomes of Sustainability?

- Increased demand = increased value;
- increased value increases importance of models & measurement
- Standardized methods
 - custom & practice
- Green is the 'new normal'
- New contractual context
 - Performance over time
 - Collaboration is crucial
 - Operations becomes key

Success must be redefined

NATIONAL GREEN BUILDING ECONOMIC IMPACT

In 2014, Canada's green building industry:



SUPPORTED 297,890 DIRECT JOBS

The portfolio of LEED® buildings in Canada certified between 2005 – 2015 will:

GENERATE CREATE 701,700 **BILLION IN** JOBS TOTAL GDP over their lifetime (direct, indirect, and induced) over their lifetime (direct, indirect, and induced) PROVIDE 28.0 **BILLION IN** ifi GROSS OUTPUT (direct, indirect, and induced)



Convergence

Sustainable Design

Sustainable Operations

Sustainable Construction

How's Canada doing?

Group by city	TOTAL
population	(10=maximum)
700,000+	
Toronto	6.9
Edmonton	6.1
Ottawa	6.0
Calgary	6.0
Montreal	5.8
250,000-699,999	
Vancouver	7.1
Mississauga	6.3
Halifax	6.2
Hamilton	6.1
Quebec	6.1
Winnipeg	5.9



THE GLOBE AND MAIL > SOURCE: BERTELSMANN STIFTUNG



E. Mitchell Swann P.E., LEED AP, F.CIBSE, C.Eng Principal - MDCSystems[®] swann@mdcsystems.com www.MDCSystems.com



E. Mitchell Swann, P.E., LEED AP swann@mdcsystems.com Principal and Partner MDC Systems, LLC www.mdcsystems.com

Mr. Swann has over 30 years of experience in the areas of engineering design, project management and consulting for a wide array of clients in diverse industries in the USA and abroad. Mr. Swann's career has included engineering design of HVAC, Piping and Control systems; Project & Department Management, Commissioning, Forensic Engineering & Expert Witness engagements; Dispute Resolution and Project Execution Consulting. He has worked for clients on commercial, institutional and high-tech\industrial projects. He has worked in A/E, E\A and Design-Build firms and Construction Management and as liaison between the design and construction team.

Mr. Swann has authored several articles on several subjects in project execution and professional practice including the "Standard of Care", Substantial Completion and Project Risk Management. Mr. Swann is active in several Technical Committees within ASHRAE, including TC 1.7-General Business, Management and Legal Education, TC 2.8-Sustainable Design, TC 7.1 – Integrated Design, TC 7.2 HVAC Design-Build and TC 9.11-Clean Spaces.

He served as President of the Engineers Club of Philadelphia from 2012 – 2014 and still sits on the Board of Directors. He is currently a Director on the Board of the Philadelphia Energy Authority where he serves as Treasurer. He is also on the PA State Uniform Construction Code Review and Advisory Council. In addition to ASHRAE, Mitch is a member of the USGBC, The Delaware Valley GBC, ISPE and the American Bar Association's (ABA) Construction Forum. He previously was vice-chair of the ABA's Alternative Dispute Resolution Section Committee on Construction.

He is a graduate of Drexel University in Philadelphia with a BSME with a concentration in Thermal Fluid Sciences (aka "Energy")

Licensed Professional Engineer: Pennsylvania, New Jersey, New York, Connecticut, California US Green Building Council LEED Accredited Professional

MDCSystems®

Providing Expert Project Delivery Solutions Worldwide

MDC Systems is a project and construction management consultancy with over 40 years of experience serving a wide array of clients and industries both nationally and around the globe.

MDC has worked on projects as diverse as residential property developments to pharmaceutical plants to highway excavation and construction.

MDC concentrates its services in primarily four areas:

program management, project management consulting, forensic engineering and construction claims consulting.

One of the key facets of **MDC's** professional staff is our expertise in the technology driven issues that are so frequently at the heart of today's complex projects.

MDC's construction claims consulting practice combines all of the skills inherent to our other service offerings and deploys it for our clients when and where projects don't go quite as smoothly as everyone had hoped. **MDC** is an industry leader in the area of construction schedule development and analysis including delay, acceleration, interruption and extended duration. **MDC** pioneered the court tested and approved Time Impact Analysis methodology for scientifically analyzing construction schedules and the impact of events upon their execution and completion.

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MDCSystems[®] Summary of Services

Program & Project Development including...

Performance Assessment & Benchmarking

Project Modeling including...

- "What if..." Scenario Analyses
- Variability/Sensitivity Analyses
- 'Out of Bounds'/"Go No Go"
 Limits

Project Planning including...

- Feasibility Studies
- Master Scheduling including...
 - Resource & Constraint Analysis

Project Monitoring including...

- Schedule Compliance
- Cash Flow & "Burn rate" projections
- Resource Utilization

Consulting Services including...

- Sustainability/Green Buildings
- Peer Review
- Practice Management

Forensic Analyses including:

- Building Systems:
 - Architectural incl. Building Envelope
 - HVAC/Mechanical, Electrical & Piping
 - Structural
 - Instrumentation & Controls
- Design Errors & Omissions (Standard of Care)
- Differing Site Conditions

Forensic Project Management®

- Schedule Analysis
 - Delay, Disruption, Suspension & Acceleration
- Labor Productivity & Inefficiency
- Scope Definition and Change
- Termination Default or Convenience
- Procurement Bid/Award Transparency

Forensic Accounting including...

- Valuation of Damages
 - Overhead & General Conditions
- Business Interruption & Lost Profit

Selected Recent Assignments

Engineering Consulting and Technical

Analyses:

- Analysis of Moisture Migration and RH Control in a Microelectronics Product R&D Facility (Colorado).
- Analysis and Improvement of Energy Consumption at a "Green" School (Pennsylvania)
- Peer Review & Design Supervision for a Radiant Heating/Cooling Floor System (New Jersey)
- Peer Review of Schematic Engineering Design Effort for Hospital Complex (Qatar)
- Analysis of Formaldehyde Outgassing from Construction Materials (Pennsylvania)
- HVAC System Failures in Pharmaceutical Packaging Facility (New Jersey)
- Analysis of Process Technology Failure at Waste Treatment Plant (New Jersey)
- Analysis of Piping System Joint Failures at a Hospital central Plant (New Jersey)
- Analysis of Destructive Vibration\ Harmonics on Large Industrial Compressors at a Chemical Plant (Louisiana)

Project Management, Execution & Construction Claims :

- Excess Rock Excavation Claim on a Highway Project -Unforeseen Conditions (New Jersey)
- Electrical Contractor Inefficiency Claim on Multi-Prime Project (New Jersey)
- Electrical Usage Charge Dispute Between Landlord & Tenant (New York)
- Schedule Delays and Change Orders on multiple Airport Projects for Major Equipment Supplier (various)
- Schedule Delays and Associated Cost Overruns for Underwater Pipeline Project (Ireland)
- "Standard of Care" Defense Design of a Food Processing Facility (Pennsylvania)
- "Custom & Practice" Specifications Development and Bid Transparency Issues (California)
- "Standard of Care" Defense Design and Documentation of a Pharmaceutical Plant using 3D Modeling (Texas)
- "Standard of Care" Plaintiff Delay and Cost Overruns for a Pharmaceutical Plant using 3D Modeling (Singapore)