

KaCee Enterprises, LLC.

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February 20, 2010

Brian Clements, AIA, LEED
1039 College Street, Suite 404
Bowling Green, KY 42101

Re: Indoor Air Quality Testing at Holy Spirit Catholic Church (4754 Smallhouse Road, Bowling Green)

Dear Architect Clements:

Enclosed is a copy of the final report summarizing our findings during the Indoor Air Quality Testing for LEED parameters at Holy Spirit Catholic Church building located at 4754 Smallhouse Road, Bowling Green, KY. Thank you for the opportunity to work with you on this project. Please let me know if you have any questions concerning this report or if I can be of additional assistance.

Respectfully,



Emmanuel Iyiegbuniwe, Ph.D.
Senior Consultant and Project Director
KaCee Enterprises, LLC.

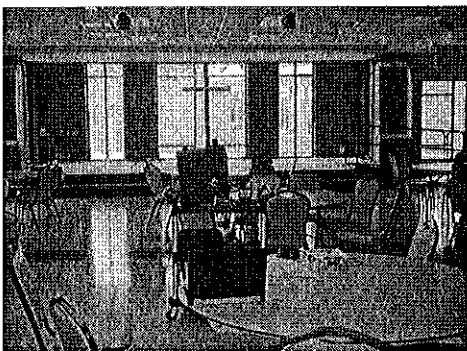
1. Introduction:

KaCee Enterprises, LLC (KaCee) was retained by Architect Brian Clements to conduct indoor air quality testing at the newly completed Holy Spirit Catholic Church building located at 4754 Smallhouse Road, Bowling Green, Kentucky. The study was conducted as part of the US Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) certification process which stipulates, among other things that points be awarded for energy conservation and other green-related demonstrations as well as demonstrating that selected air contaminant concentrations be below certain target levels (IEQ 3.2: Indoor Air Quality Management Plan After Construction). In general, most contaminants generated indoors are often associated with either people or the building and its furnishings.

2. Methods:

KaCee collected and analyzed air samples for the following LEED chemicals: Total Volatile Organic Compounds (VOCs), Particulate Matter less than 10 μ in size (PM₁₀), Formaldehyde, and Carbon Monoxide (CO). Another LEED chemical, 4 phenyl cyclohexane (4-PCH) was excluded in the test since it was not present in any of the carpets and/or interior finishing used at the facility. The IAQ tests were conducted on February 13, 2010 (on 2/16/2010 for the Youth Center) over a period of approximately 6 hours. Measurements were made during normal occupancy hours with all interior furnishings already installed and the ventilation system operating at normal levels (per LEED Reference Guide for Green Building Design and Construction, 2009). The tests were conducted in accordance with the requirements of the US Environmental Protection Agency (EPA) "Compendium of Methods for the Determination of Air Pollutants in Indoor Air."

Samples were collected at about 4 feet above floor level using the GrayWolf Pack DirectSense IAQ Plus, the PM-205KIT Particulate Monitor and the RK-FP30 Formaldehyde meter. The IAQ Plus is equipped with the WolfSense PPC application software with direct-reading and data-logging capabilities for the measurement of TVOCs and CO (also measures Relative Humidity, Carbon Dioxide and Temperature). Formaldehyde was measured with the RK-FP30, a direct-reading handheld optical meter. All the samples were collected at the following locations throughout the building: Group Room 184, Spirit Hall, Lobby-Room 101, Office-Reception Room 122, Paraclete Conference Room 141, Office-Room 132, Copier-Work Room 123, Angeles Room 195, Patience Room 173, and Youth Center Room 176.



3. Results and Discussion:

The IAQ test results are summarized in Tables 1 and 2 (the print-outs are attached). The results showed that all four parameters tested were well below their respective USGBC LEED IEQ Target concentrations (Reference Guide 2009 Edition). TVOCs concentrations ranged from 0.0 to 56 $\mu\text{g}/\text{m}^3$, compared to a LEED target of less than 500 $\mu\text{g}/\text{m}^3$. No particulate matter (PM_{10}) was recorded in all the areas tested (except the Spirit Hall with a concentration of 6.6 $\mu\text{g}/\text{m}^3$ compared to a LEED target of less than 50 $\mu\text{g}/\text{m}^3$). Formaldehyde and carbon monoxide were barely detected in all the areas (0.0 – 0.40 ppb and 0.0 – 0.26 ppm, respectively)

In addition, the levels of basic IAQ parameters including carbon dioxide and temperature (not included in the LEED tests) measured in all the areas were within the acceptable limits recommended by the American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE). Temperature and humidity are comfort parameters while Carbon dioxide is a surrogate measure of the adequacy of dilution air distribution to occupied indoor areas.

LEED concentrations for these chemicals are building emission levels obtained if low TVOCs and other low materials have been installed – these pollutants, if present at above recommended levels may potentially impact the productivity and long-term health of the occupants.

Table 1. Results of IAQ Testing for TVOCs, PM_{10} , Formaldehyde and Carbon Monoxide

S/N	Sampling Location	Room #	Total Volatile Organic Compounds, TVOCs ($\mu\text{g}/\text{m}^3$)	Particulate Matter, PM_{10} ($\mu\text{g}/\text{m}^3$)	Formaldehyde HCHO (ppb)	Carbon Monoxide, CO (ppm)
1	Group Room /Awe	184	16.0	0.0	0.015	0.0
2	Youth Center Room	176	8.7	0.0	<0.010	0.26
3	Spirit Hall	107	2.0	6.6	<0.010	0.0
4	Office Area- Reception	122	51	0.0	0.040	0.0
5	Paraclete Conference Room	141	56	0.0	0.025	0.0
6	Carol's Office	132	56	0.0	0.035	0.0
7	Copier-Work Room	123	56	0.0	0.035	0.1
8	Angeles Room	195	0.0	0.0	0.015	0.0
9	Patience Room	173	0.0	0.0	<0.01	0.0
USGBC LEED IEQ Target (Reference Guide 2009)			<500	<50	<27	<9 and/or ≤ 2 above outdoor

Table 2. Results of IAQ Testing for Carbon Dioxide, Relative Humidity and Temperature

S/N	Sampling Location	Room #	Carbon Dioxide (ppm)	Temperature (°F)	Relative Humidity (%)
1	Group Room /Awe	184	602	68.3	16.2
2	Youth Center Room	176	606	68.7	16.5
3	Spirit Hall	107	542	71.6	13.8
4	Office Area- Reception	122	626	74.1	15.6
5	Carol's Office	132	667	73.2	17.1
6	Copier-Work Room	123	664	73.6	16.7
7	Angeles Room	195	658	61.8	22.7
8	Patience Room	173	576	69.7	16.2
9	Outdoor	---	505	38.2	30.2
ASHRAE's Recommended Acceptable Limit/Range			≤700 above outdoor	68-74 (Winter Period)	30 – 60

4. Conclusion:

In recent years, green building certification has become an increasingly important issue for businesses. KaCee was retained to conduct IAQ testing for four LEED chemicals of concern (TVOCs, PM₁₀, Formaldehyde, and Carbon Monoxide). Measurements were made over a period of approximately 6 hours during normal occupancy hours with all interior furnishings already installed and the ventilation system operating at normal levels (per LEED Reference Guide for Green Building Design and Construction, 2009). The IAQ results showed that all four parameters tested were well below the allowable LEED IEQ limits (Reference Guide 2009 Edition).

(Trend Log printouts are attached)

HolySpiritCatholicChurch_IAQ Test

DateTime	TVOC ppb	CO2 ppm	CO ppm	Oxygen %	Temperature °F	Humidity %RH	Dew Point °F
16-Feb-10 06:24:48 PM	32	577	0.3	21.3	68.6	16.3	21.2
16-Feb-10 06:39:48 PM	28	574	0.3	21.2	69.3	16.2	21.6
16-Feb-10 06:54:48 PM	23	543	0.3	21.1	69.2	15.5	20.5
16-Feb-10 07:09:48 PM	17	528	0.3	21.1	68.9	15.3	20.0
16-Feb-10 07:24:48 PM	12	538	0.3	21.1	68.5	15.4	19.8
16-Feb-10 07:39:48 PM	12	568	0.3	21.0	68.6	15.7	20.4
16-Feb-10 07:54:48 PM	10	655	0.3	21.0	68.8	16.5	21.5
16-Feb-10 08:09:48 PM	11	706	0.3	20.9	69.0	16.8	22.3
16-Feb-10 08:24:48 PM	10	727	0.3	20.9	69.2	17.0	22.6
16-Feb-10 08:39:48 PM	9	747	0.3	20.9	69.3	17.1	22.9
16-Feb-10 08:54:48 PM	8	756	0.2	20.9	69.2	17.3	23.1
16-Feb-10 09:09:48 PM	10	761	0.2	20.9	69.2	17.4	23.2
16-Feb-10 09:24:48 PM	8	700	0.3	20.9	69.2	17.1	22.7
16-Feb-10 09:39:48 PM	7	652	0.2	20.9	69.0	16.9	22.3
16-Feb-10 09:54:48 PM	6	622	0.3	20.9	68.9	16.8	22.2
16-Feb-10 10:09:48 PM	4	597	0.2	20.9	68.7	16.7	21.9
16-Feb-10 10:24:48 PM	1	573	0.3	20.9	68.5	16.6	21.6
16-Feb-10 10:39:48 PM	0	557	0.2	20.9	68.3	16.6	21.4
16-Feb-10 10:54:48 PM	0	545	0.2	20.9	68.4	16.5	21.3
16-Feb-10 11:09:48 PM	0	534	0.2	20.8	68.3	16.5	21.2
16-Feb-10 11:24:48 PM	0	526	0.3	20.8	68.2	16.5	21.0
16-Feb-10 11:39:48 PM	0	519	0.2	20.8	68.1	16.4	21.0
16-Feb-10 11:54:48 PM	0	515	0.2	20.8	68.0	16.4	20.9
17-Feb-10 12:09:48 AM	0	513	0.2	20.8	67.8	16.4	20.7



Gray Wolf Sensing Solutions Calibration Certificate

Model # IQ-610 Indoor Air Quality Probe with PID
Serial # 05-224
Multiprobe: Yes
Date: 8th Feb 2010

Temperature		
Actual (+/-0.3°C)	23.50°C	41.75°C
Measured	23.50°C	41.75°C

Relative Humidity		
Actual (+/-2%rh)	11.70%	84.70%
Measured	11.70%	84.70%

TVOC (Socket 4) (Sensor serial # H1164 ppb)		
Actual (+/-2%)	0ppb	7530ppb
Measured	0ppb	7530ppb

Carbon Dioxide (Socket 2) (Serial # MT 006827)		
Actual (+/-2%)	300ppm	1000ppm
Measured	300ppm	1000ppm

Carbon Monoxide (Socket 5) (Serial # 11124501097)		
Actual (+/-2%)	0ppm	95ppm
Measured	0ppm	95ppm

Calibration: Location1

Calibration as of 16-Feb-2010 18:09:48

Calibration information for IQ610 probe s/n 05-224 id=4

Last Calibration: 08-Feb-2010 10:50:43

TVOC: @+0.00ppb on 08-Feb-2010 (Factory)

TVOC: @+7530.00ppb on 08-Feb-2010 (Factory)

Carbon Dioxide: @+301.00ppm on 08-Feb-2010 (Factory)

Carbon Dioxide: @+1000.00ppm on 08-Feb-2010 (Factory)

Carbon Monoxide: @+0.00ppm on 08-Feb-2010 (Factory)

Carbon Monoxide: @+94.90ppm on 08-Feb-2010 (Factory)

Temperature: @+23.50C on 08-Feb-2010 (Factory)

Temperature: @+41.75C on 08-Feb-2010 (Factory)

Relative Humidity: @+11.70%RH on 08-Feb-2010 (Factory)

Relative Humidity: @+84.70%RH on 08-Feb-2010 (Factory)

Oxygen: @+0.00ppm on 08-Feb-2010 (Factory)

Oxygen: @+20.90ppm on 08-Feb-2010 (Factory)
