ASHRAE TECHNOLOGY AWARDS APPLICATION FORM (Page 1)

APPLICATION MUST BE COMPLETE TO BE CONSIDERED FOR JUDGING

(Required for Society-Level Competition)

(For ASHRAE Staff Use Only)

I. Identification (0 Points)

Name of building or project: Stew and LeNore Hansen Football Performance Center

II. Category - Check one and indicate New, Existing, or Retrocommissioning (RCx)

☐ Commercial Buildings	☐ New	☐ Existing	☐ RCx
Institutional Buildings:			
☒ Educational Facilities	☒ New	☐ Existing	☐ RCx
☐ Other Institutional	☐ New	☐ Existing	☐ RCx
☐ Health Care Facilities	☐ New	☐ Existing	☐ RCx
☐ Industrial Facilities or Processes	☐ New	☐ Existing	☐ RCx
☐ Public Assembly	☐ New	☐ Existing	☐ RCx
☐ Residential (Single and Multi-Family)			

III. Project Description (0 Points)

1. Type of building or process: Division I university athletics building
2. Size – gross floor area of building (ft. sq. or m. sq.): 224,000 SF
3. Function of major areas (such as offices, retail, food services, laboratories, guest/patient rooms, laundry, operating rooms, warehouse/storage, computer rooms, parking, manufacturing, process, etc., or industrial process description:
   Strength and conditioning areas, locker rooms, sports medicine, meeting rooms, offices, conference rooms, exam and treatment rooms, physical therapy, laundry, kitchen and dining, indoor practice field
4. Project study period: 03/2009 (Begin date (mm/yyyy)) to 08/2014 (End date (mm/yyyy))
5. Project Occupancy and Operation Period: 10/2012 (Begin date (mm/yyyy)) to 03/2016 (End date (mm/yyyy))
6. ASHRAE Standards referenced during design (this information will not be shared with the Judging Panel):

   ASHRAE 90.1.2007

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1. Name of Building or Project: Stew and LeNore Hansen Football Performance Center

2. Entrant (ASHRAE member with significant role in project):

a. Name: Pearce (Last) Lincoln (First) D. (Middle)

Membership Number: 5103550

Chapter: Iowa

Region: VI

b. Entrant's Design Firm/Company: KJWW Engineering Consultants

c. Address (including country): 2882 106th St.

Des Moines, IA 50322 (City, State, Zip) U.S. (Country)

d. Telephone: (O) (515) 334-7937 e. Email: pearceld@kjww.com

f. Entrant's Role in Project: Project Executive and Lead Mechanical Engineer

g. List the names of Design Team Members (A maximum of three may be listed below)

1. Substance Architecture: Tim Hickman, Joshua Baker, Leah Rudolphi
2. KJWW Engineering Consultants: Lincoln Pearce, Ryan Chapman, Bob Brown
3. The Weidt Group: Jason Steinbock, Doug Wolf

3. Certification of entrant (0 Points) (If multiple entrants, all must be listed on this form)

I certify the information submitted is correct, and that this entry satisfies the requirements of the ASHRAE Technology Award competition.

Typed Name: Lincoln Pearce Title: Project Executive

Signature: Lincoln D. Pearce Date: 3-3-16

4. Building Owner's release (0 Points)

I certify that I am the owner or the authorized representative of this project, and hereby grant permission to ASHRAE to use all the enclosed data and information in the judging and subsequent publicity of this project.

Typed Name: Glen Mowery Title: Director, Utilities & Energy Management

Signature: Glen Mowery Date: 3/2/16

(Signatures must be on form submitted to ASHRAE)

Company: University of Iowa

Address: Facilities Management, 250 USB, University of Iowa

Iowa City (City) IA (State) 52242 (Zip) US (Country)

Telephone: (O) (319) 335-1884 Email: glen-mowery@uiowa.edu

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5. **Engineer of record:** Required unless a written explanation is provided why the engineer of record will not grant his/her consent.

I consent to the presentation of this project for consideration in the ASHRAE Technology Awards Program.

Typed Name: Lincoln Pearce Title: Project Executive

Signature: Lincoln D. Pearce Date: 3·3-16

(Signatures must be on form submitted to ASHRAE)

Company: KJWW Engineering Consultants

Address: 2882 106th St.

Des Moines, IA 50322 U.S.

City State Zip Country

Telephone: (O) (515) 334-7937 Email: pearceld@kjww.com

The topics below should be addressed on separate pages and formatted according to the requirements listed in the overview.

1. **Energy Efficiency (15 Points)**
2. **Indoor Air Quality (15 Points)**
3. **Innovation (15 Points)**
4. **Maintenance & Operation (15 Points)**
5. **Cost Effectiveness (15 Points)**
6. **Environmental Impact (15 Points)**
7. **Quality of Presentation (5 Points) (No response required)**

Return Completed Application to your Chapter Technology Transfer Committee Regional Vice-Chair.

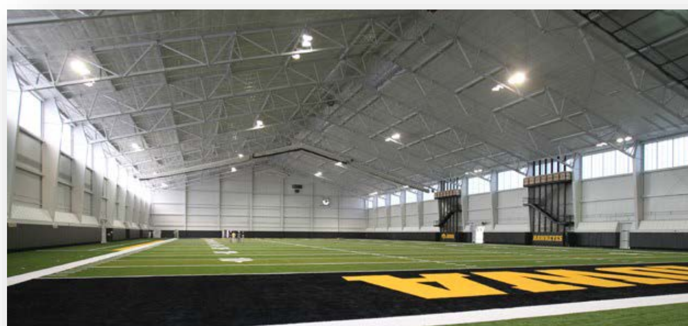
For additional information, contact:

Candace Pettigrew
Chapter Programs Manager
678/539-1128
cpettigrew@ashrae.org

University of Iowa Football Performance Center

Supporting narrative for the 2016 ASHRAE Technology Awards

The $55 million Stew and LeNore Hansen Football Performance Center – the new home of the University of Iowa's Division I Football program – consists of two attached buildings constructed in two phases. Phase I produced the new 112,500-square-foot indoor practice facility; Phase II completed the project with construction of the 111,500-square-foot football operations facility.



The indoor practice facility replaced an inefficient air-supported structure that had lived beyond its useful life. It houses a large indoor practice field with field turf, three filming platforms, equipment storage space, restrooms and other support spaces. The two-story football operations building's first floor houses strength and conditioning space, locker rooms for student athletes and coaches, a lobby and entertainment space reminiscent of a hall of fame, sports medicine space, and space for equipment distribution and maintenance. The mezzanine level includes team and position meeting rooms, office space and conference rooms for members of the coaching and administrative staffs, multi-purpose recruiting space, and space for video operations. Other spaces include exam rooms, taping/treatment rooms, physical therapy, kitchen and dining, and laundry.

Energy efficiency

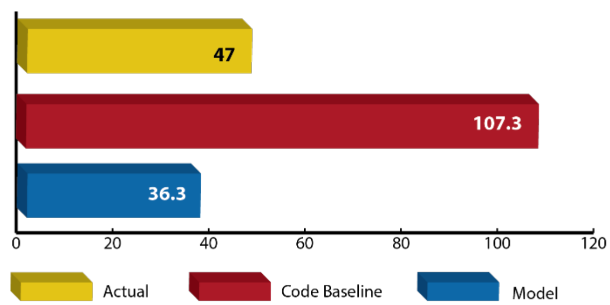
The Football Performance Center is part of the university's campus master plan, which seeks high-performance buildings that support the school in its desire to use no more energy in 2020 than it did in 2010, despite growth and expansion. The center is on track to achieve LEED Gold certification, and its original design criteria included the following parameters:

- Heating only for the phase 1 practice facility, a high-bay space in which only the lowest 10 percent of the volume is occupied
- Heating and cooling for the phase 2 operations building
- Quiet system operation
- Optimization of tight site space to maximize the indoor practice field area and reduce mechanical space
- A desire to use campus chilled water (which was nearby and plentiful) and steam (which would cost an additional $1 million to connect)

Four HVAC systems were considered, modeled and analyzed for energy efficiency, life cycle cost and payback. The chosen design utilizes a water-to-water heat pump system – the center's main energy-saving feature – that uses the campus chilled water to provide heat for the entire center. Radiant floor heating was selected to disperse the heat in the practice facility.

Energy modeling was conducted by The Weidt Group as part of the Energy Design Assistance Report for MidAmerican Energy’s Commercial New Construction Program. The modeling (using DOE 2.2) was based on ASHRAE 90.1-2007. Energy modeling showed the proposed design model to use 66 percent less energy than the code baseline model (campus chilled water and electric boiler, with radiant floor heat for the practice field). The design model has an EUI of 36.3 kBtu/sf/year compared to the baseline model EUI of 107.3 kBtu/sf/year. The center’s actual EUI for the previous 12 months ending in February 2016 is 47 kBtu/sf/year – 56 percent less than the baseline.

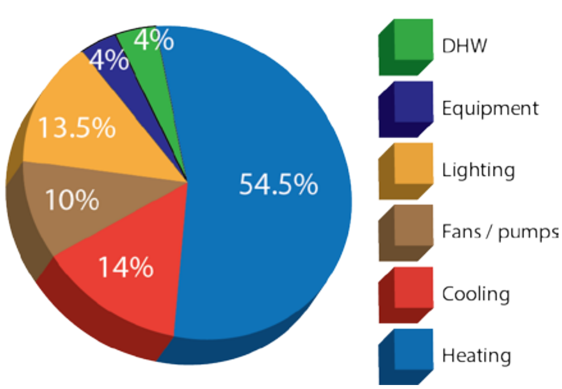
Energy Use Intensity (EUI) in kBtu/sf



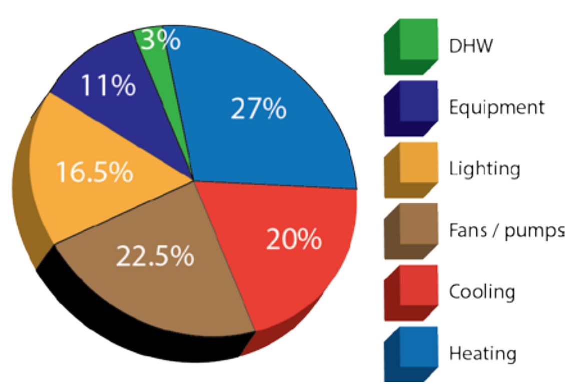
Source: The Weidt Group and UI Utilities and Energy Management Group

Energy modeling also shows that the district chilled water and water-to-water heat pump system account for 50 percent of the total verified energy cost savings. (The system energy cost pie charts, below, show heating and cooling accounting for 68.5 percent in the baseline model versus just 47 percent in the design model; heating energy percentage of total is halved in the design model.) Total energy recovery wheels and CO2 control of outside air each account for another 8 percent of the overall savings.

Baseline Model % Energy Cost



Design Model % Energy Cost



Source: The Weidt Group and UI Utilities and Energy Management Group

Many smaller strategies comprise the remainder of the energy savings and include variable frequency drives, daylight harvesting, LED lighting, dimming daylighting controls, occupancy sensors, low-flow plumbing fixtures, radiant floor heating and natural ventilation (both only in the indoor practice facility).

The center's modeled energy performance was the best among new construction projects in Iowa in 2015, winning first place in MidAmerican Energy's Commercial New Construction Program.

Indoor air quality

The Football Performance Center was designed to and complies with ASHRAE 62.1-2007 and used the Ventilation Rate Procedure. The project also was designed to and complies with ASHRAE 55-2004.

Natural ventilation was integrated into the architecture of the indoor practice facility for cooling and ventilating the space during hot summer conditions. Outside air is introduced to the practice field area at the turf level. Air is relieved from the space by natural thermal buoyancy through four large roof monitors. Building controls monitor building pressure and can adjust airflow to limit negative pressure in the building. On a 90-degree day, the temperature inside the practice facility was measured to be 10 degrees cooler than the outdoors.

During the cold months, the radiant floor puts the heat close to the occupants, who will be exercising vigorously within the lowest 6½ feet of the 75-foot-tall "barn." The space is designed to maintain a floor temperature of 72°F with overrides to limit the space heating temperature between 50°F and 65°F. The radiant heating system also provides a much quieter environment, eliminating fan and air circulation noise that would accompany a system that requires air rotation. A dedicated outdoor air unit with a total energy recovery wheel provides code ventilation in the winter when the natural ventilation system is closed.

Different strategies for achieving indoor air quality and thermal comfort exist in the operations building, which uses overhead heating and cooling and has spaces such as offices, locker rooms, meeting rooms, hydrotherapy pools, etc. The locker rooms have a 100 percent dedicated outside air unit for odor control during occupied times, and are maintained at negative pressure relative to the rest of the building. To save energy during unoccupied times at night, some air is recirculated by the dedicated AHU and passed through charcoal filters to comply with ASHRAE Standard 62. As a result of these measures, odor complaints have been non-existent.

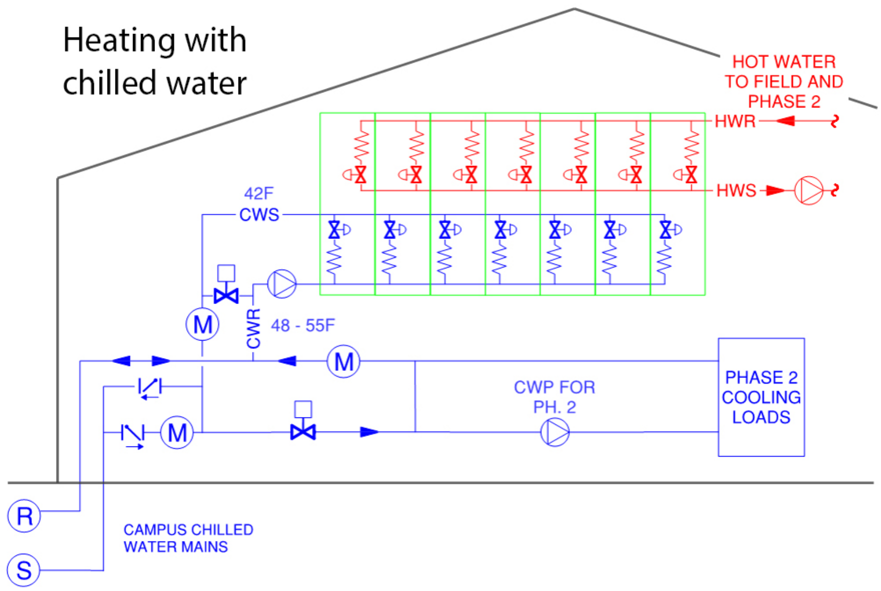
The therapy rooms and two plunge pools also each have dedicated AHUs and are maintained at negative pressure relative to the rest of the building.

Football pads and other perspiration-soaked equipment are collected in a specially designed drying room. This heavily insulated and heated space dries out the equipment, with all moisture and potential for mold exhausted from the building.

Innovation

The major innovative aspect of the project is the coupling of the campus chilled water with the water-to-water heat pump system, which uses the chilled water return loop as a heat sink to heat the entire center. This allowed the university to avoid spending $1 million associated with bringing campus steam to the center.

The water-to-water heat pumps have a coefficient of performance of 2.6 for heating, and 4.6 for simultaneous heating and cooling. As a "byproduct" of the system operation, more than 400 tons of



usable chilled water is created for use within the same facility, or elsewhere on campus. The table below shows the monthly total energy use and chilled water use for the building. From June to September the building uses all the chilled water it produces, and gets the rest, about 50 percent, from the campus supply. However, in the winter and shoulder months the building

Facility Total Energy and Chilled Water Use / Production Summary *

Month	Electric (KWH)	Electric (MMBTU)	CW Purchased by Building	Total Billed to Building	CW Produced and Used by Building	CW Produced and Sent to Campus Loop
Mar-15	195,236	666	0	666	165	212
Apr-15	157,583	538	58	596	255	57
May-15	151,841	518	283	801	325	20
Jun-15	161,030	549	589	1138	257	0
Jul-15	157,925	539	777	1315	279	0
Aug-15	162,225	554	777	1330	383	0
Sep-15	164,950	563	570	1133	454	0
Oct-15	176,959	604	116	720	286	113
Nov-15	184,602	630	0	630	256	152
Dec-15	197,545	674	0	674	188	223
Jan-16	260,274	888	0	888	126	414
Feb-16	236,800	808	0	808	127	290
Total	2,206,970	7,530	3,170	10,700	3,101	1,481
KBTU/GSF		33	14	47	14	7
Cost	$ 207,900		$ 79,470	$ 287,370	$ 77,740	$ 37,130

* In MMBTU unless otherwise noted.

Source: UI Utilities and Energy Management Group meets its chilled water needs and creates and pumps an additional 1481 MMBtu of chilled water into the campus supply loop. Over a one year period from March 2015 through February 2016 the building's heat pump system produced 4582 MMBtu of its required 6201 MMBtu of chilled water – the equivalent of 73 percent of its annual need.

Other innovative applications of existing technology on the project are:

- Use of in-floor radiant heat under the turf field for practice facility heating
- Use of natural/displacement ventilation as primary means of summer conditioning in the practice facility, supplemented with energy recovery ventilation and exhaust fans
- The design of the heavily insulated and heated pad drying room

Operation and maintenance

Due to its radiant floor heating system, the football practice facility has minimal fan systems to maintain other than the small ventilation unit used in the winter, and three sidewall exhaust fans that can be used to supplement the natural ventilation if desired. Had the designers chosen a system with air rotation devices, more maintenance would have been required.

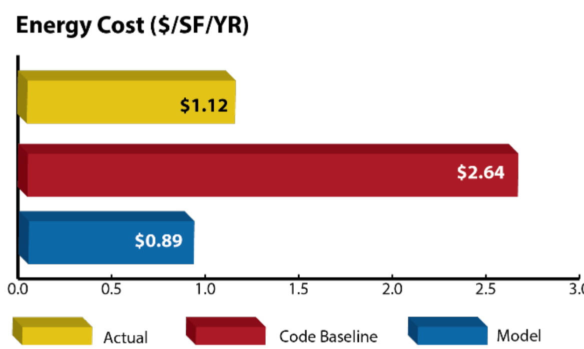
In the warm months, the practice facility's natural ventilation and relief of air by thermal buoyancy through the roof monitors require virtually no maintenance.

The mechanical systems in the operations building require only typical maintenance, and the majority of the AHUs are located in an indoor walkable penthouse for easy access. Some complexity does exist with the water-to-water heat pumps, which are located on the ground floor for ease of maintenance. The design team spent a considerable amount of time training facilities personnel in the operation of the system, which has inherent redundancy based on multiple units having been installed. While slightly higher maintenance is expected for this system, it is well within the capabilities of staff.

The mechanical systems were commissioned to meet LEED v3 requirements for enhanced commissioning, EAc3. This helps ensure that the designed sequences of operation and expected performance of the equipment are actually met, and also helps correct potential energy-wasting errors that may have occurred during construction and programming.

Cost effectiveness

The $55 million construction budget (which includes the cost of the added conservation measures) for the 214,000-square-foot-facility equated to just $257 per square foot — a modest figure by today's standards.



Source: The Weidt Group and UI Utilities and Energy Management Group

The design team created four system bundles for final modeling, with all bundles subjected to life cycle cost analysis, including payback of the added conservation measures. Energy modeling showed the chosen design model to use 66 percent less energy than the baseline model. Actual energy cost per square foot per year for FY 2015 is $1.12, 58 percent less than the baseline of $2.64 sf/year.

The project's added conservation measures resulted in an incremental construction cost of $1,618,804. Due to the implementation of these energy savings strategies, however, MidAmerican Energy Company offered an incentive of $743,200, resulting in an adjusted incremental energy investment construction cost of $875,604.

With modeled annual energy savings versus baseline projected at $356,157, the energy investments have a payback projection (with incentive) of just 2.5 years.

Environmental impact

Beyond energy savings, the center possesses the following environmentally-friendly attributes, as stated on the LEED Certification Review Report:

- High-efficiency plumbing fixtures and controls, which contribute to a projected water savings of 45 percent compared to a baseline building per LEED v3
- 32 percent of total building materials content, by value, manufactured using recycled materials
- 97 percent of on-site generated construction waste diverted from the landfill
- 13 percent of the total building materials regionally extracted, harvested or fabricated
- Low-V.O.C. materials used throughout the building
- A phase-out plan for the discontinuation of CFC-based equipment
- Mass transit access within ¼-mile walking distance
- Bicycle storage and shower facilities

Conclusion

The University of Iowa is committed to sustainability and energy efficiency and hoped the Football Performance Center would reinforce this commitment. Its goal for the center was to perform 30 percent better than the ASHRAE 90.1-2007 baseline, and the building's performance has nearly doubled that, with actual energy use currently 56 percent better than the modeled baseline. (In order to address the higher-than-expected EUI – 47 instead of 36 – the university plans to enroll in the MidAmerican Energy Ongoing Performance Track program to recalibrate the energy model to actual usage and identify additional energy-saving opportunities.)

The energy-efficient design of the center has proven itself, and the innovative use of campus chilled water with water-to-water heat pumps is being replicated as an energy-saving measure at other new buildings on campus. Just as importantly, the systems design of the center optimizes conditions for the end users – players, coaches and staff.

A story published Aug. 25, 2015, in The (Iowa City) Gazette characterized the center as a "self-contained football training ground. . . . From the cold tubs to the locker rooms to . . . the 100,000 square foot indoor football facility (which is attached to the weight room with the players' classrooms just upstairs), efficiency was the goal."

"Our objectives were simple," the story quotes head coach Kirk Ferentz as saying. "We wanted a building that was going to be first class, but not opulent. … We wanted this place to be functional, and it's functional in every turn."