A critical case study of decision criteria in architectural competitions

Ulrich Pont[1)], Kristina Kiesel[1)], Matthias Schuss[1)],
Bernhard Sommer[2)], Kristina Orehounig[1)], and Ardeshir Mahdavi[1)]

1) Dep. of Building Physics & Building Ecology, VUT, Karlsplatz 13/4 A-1040 Vienna, bpi@tuwien.ac.at
2) Energy Design, University of applied Arts Vienna, Oskar Kokoschka-Platz 2, A-1010 Vienna, energie.design@uni-ak.ac.at

1 ABSTRACT

This paper analyzes a number of design proposals submitted within the framework of a large architectural competition in view of their eco-efficiency. As all new or refurbished buildings in Central Europe need to meet certain minimum energy performance requirements, many architectural competition announcements encourage participating planners to propose low-energy, passive or even plus-energy buildings, and also to take into account the ecological performance of building parts. Especially for public buildings, which are often seen as role models, competition announcements feature many environmental criteria addressing building envelope, HVAC-systems, and eco-impact of materials. It is difficult to compare project submissions (for example in terms of energy performance), as the quality and amount of information for each project varies widely. In most competitions, a professional jury chooses the “best” projects and it is debatable if ecological and energy performances are considered in the process. In this context, this paper presents results of a case study conducted in Austria. The entries of a competition for refurbishment and extension of a school building are analyzed using submitted project narratives as well as simple heating demand calculations. The outcome is subsequently compared with the Jury's final ranking of the submissions. The results can shed some light on the following questions: Do the competition entries provide sufficient information to evaluate their thermal and ecological behavior in general? Did the ecological and thermal performance influence the outcome of the competition and final Jury's ranking of the submitted proposals?

2 INTRODUCTION

New constructions and the refurbishment of existing buildings must target good energy performance, generate fewer emissions, and display high levels of sustainability. Buildings are complex systems and it is a challenge for planners to fully understand the relevant interactions and the influences and how they affect the buildings' performance. In addition to a good architectural concept, user comfort, and functional soundness, building requirements include:

- low heating demand,
- minimized overheating,
- sufficient daylight penetration and a good electrical lighting concept,
- appropriate acoustical conditions, and
- optimal ecological performance (sustainability).

Most large constructions and public buildings are initiated via an architectural competition or open competitive bidding. Also more and more private clients tend to use similar public or partially public procurement and open competition procedures. In most cases, the competition announcements include – in addition to functional needs – some or all of the above mentioned requirements. The selection process in such competitions is not always comprehensible, and it is in most cases impossible to determine the influence of certain – especially energy related or ecological – criteria. Moreover, the aforementioned complexity of buildings, the expenses, and the time pressure make it difficult for designers to respond to all of the requirements in a sufficient way. Additionally, the results of these considerations are in most cases not comparable to other competition entries. This shows the need for standardized procedures to evaluate certain criteria within a competition. Hausladen et al. (2010) analyzed different methods that could be used for evaluation of competition entries. This includes the SNARC method, Solar-computer and the Energy Design Guide. SNARC (SIA 2004) was developed by the University of Zürich in Winterthur and is used to evaluate the ecological performance of architectural designs. This method evaluates the designs in view of their impact on the surrounding environment, the lifecycle performance, and the functionality. No additional work from the planners is required in order to limit the effort to participate in competitions. It is recommended to analyze the submissions after a first selection. Solar-computer calculates the heating energy of the proposed design taking into account the volume and the surface area [SOL]. The Energy Design guide consists of 2 parts. Part I focuses on the building envelope, mainly the solar gains in buildings. The Energy design guide II focuses on the heating and cooling loads [ENERGY]. Hausladen et al. (2010) point out that the ecological and energetic requirements and procedures have to be defined clearly in the bidding announcement and the criteria and method for evaluation of these factors have to be established early in the process. Klooz and Dellenbach (2005) analyzed an architectural competition for the Roll-Areal in Bern. They looked at the sustainability of the proposed designs. Jury members were asked to evaluate the 10 first ranked competition entries regarding defined criteria. The examination showed a different ranking of most of the projects, but the winner in the competition was also the best one regarding sustainability. Klooz and Dellenbach (2005) pointed out the importance of a preliminary survey, in order to have more time and resources to evaluate the remaining projects in more detail. Mahdavi and El-Bellahy (2004) investigated an architectural competition for a school building in Weyer (Austria). They looked at the relative performance of the projects in terms of nine environmental impact indicators. The finding was that the jury took little note of these sustainability criteria.

Similar to the last mentioned paper, this study looks at a recent architectural competition for a school building in Austria. All of the projects are evaluated towards predefined sustainable keywords in the description. Furthermore, the 7 awarded projects have been analyzed towards their heating load. Furthermore, the heating load of the 7 projects, which performed best in the analysis of the keywords are calculated.

3 METHODOLOGY

3.1 The architectural competition

3.1.1 <u>The project</u>

The competitions is about the reorganization of an existing school campus in lower Austria. This includes the adaptation and refurbishment (or partial demolition) of the existing buildings, the construction of an annex, and the reorganization of the sports facilities. The existing building complex dates back to the 1950's but has undergone minor adaptations. Additionally, a temporary container building has been added some years ago. Figure 1 shows the compound with the existing structures. Figure 2 shows the entrance to the main building.

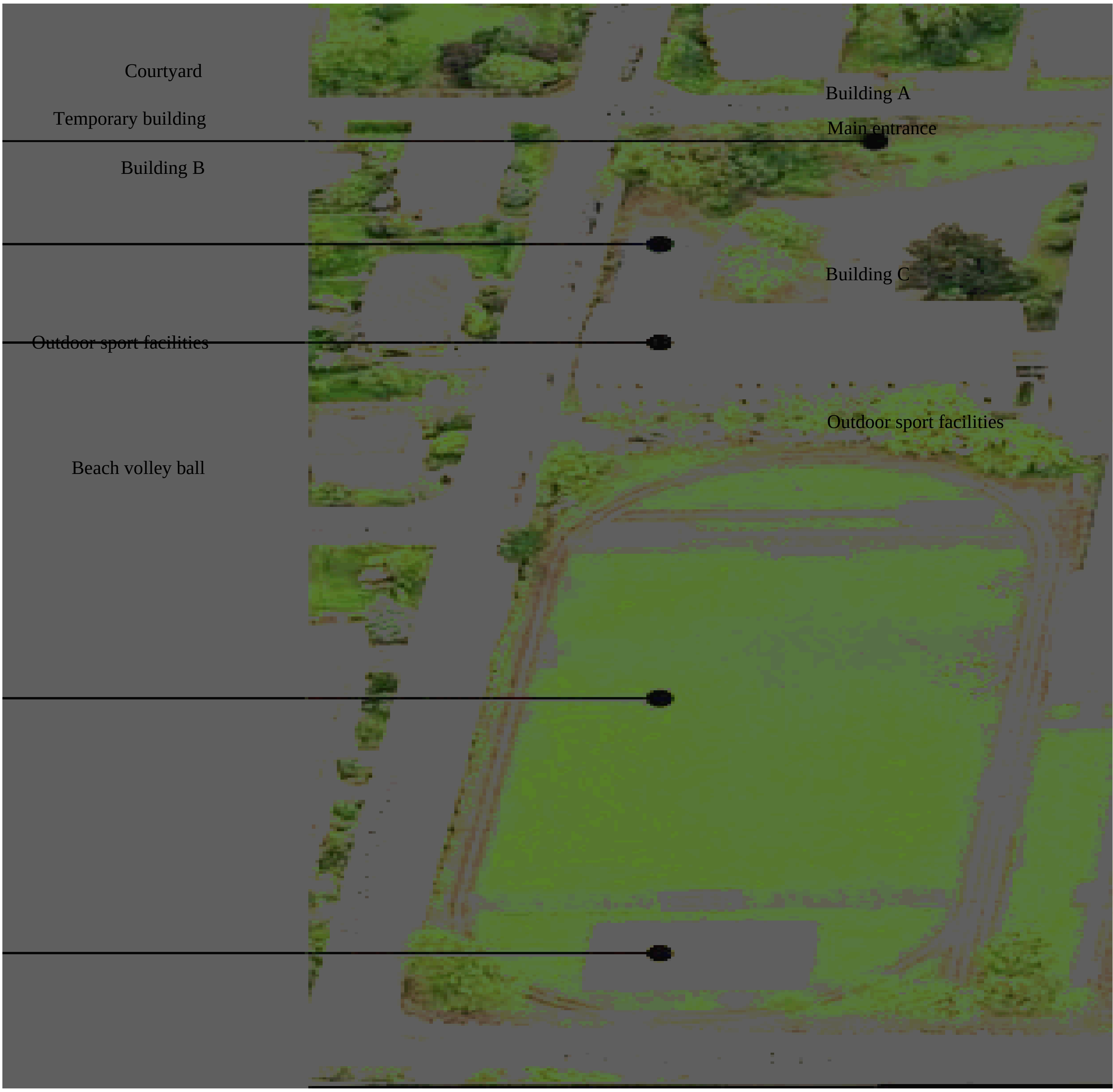


Figure 1. The existing school campus


Figure 2. Entrance to the main building

3.1.2 specifications:

Detailed specifications for this competition can be found in the public offer of a reward (NEXT-PM 2011). The financial limit was set to 11.5 Mio Euros for the whole project and the required net floor area is 5727 m² (excluding the sport facilities). Special attention is given to energy efficiency and sustainability. The competition participants are asked to include comprehensive designs for the facade, the HVAC system, the building service engineering, and the power supply. Furthermore, the facility's LCA should be taken into account. The guidelines that should be considered include amongst others the ÖISS guidelines (Austrian Institute for the construction of school buildings and sport facilities) [ÖISS], the applicable Austrian Standards (ÖNORM 2011), and the applicable planning guidelines [OIB]. The public offer of reward also requested to take into consideration a number of criteria as shown in Table 1. These criteria were also described as guideline for the evaluation by the jury.

Criteria	Description
Urbanistic	Positioning of volumes, relationship to existing buildings and surroundings.
Architectural	Conceptionel design
	Architectural quality of indoor and outdoor spaces
Functional	Pathway-design inside and outside (circulation logic)
	Requirement fullfilment (area)
	Potential and flexibility for future changes in teaching methods
Economical and ecological	Economic feasibility and energetic efficiency of design
	Economic treatment of existing building parts
	Cost effectiveness (total cost below limit)

Table 1. Details of requested criteria for the competition projects

3.1.3 Evaluation of the competition entries by the jury

In a first round, the submissions needed one positive assessment from one of the nine jury members in order to advance. In this round 26 of the 64 design proposals submitted were eliminated without any reasoning. In the second round another 24 submissions were eliminated and a short statement was made by jury for each of these projects. The same procedure was applied in the third round. The remaining 7 submissions were then ranked by the jury and a detailed evaluation was formulated. Table 2 shows the ranking of the last 7 submissions.

Ranking	Project	Short summary of the positive jury remarks
1	48	Economic and comprehensible solution, large partially shaded courtyard
2	08	Good reorganisation of sporting facilities, spectacular spaces within the building, courtyards on several levels
3	21	Flexible open spaces on the ground level, good interpretation of the idea of a new school typology

A	07	Compact new building, vegetated courtyard is maintained
A	24	Terraces on the courtyard facing facades
A	54	Airy campus situation with pavilions
A	60	Carpet with loggias and atriums, many open spaces

Table 2. The 7 best ranked submissions

3.2 Qualitative evaluation of the competition entries

The implementation of the mentioned ecological criteria was analysed by looking at the reports that go with each project. First a set of keywords was generated. Table 3 gives a summary of these keywords. The keywords address aspects of the building's design, which influence the ecological performance. As a second step, each of the 64 reports was searched for these keywords or similar terms. In a last step, the findings were qualitatively evaluated according to table 4.

Keywords mentioned
Ecologic Criteria Mentioned
Insulation
renewable energy
A/V or compactness
Daylight & Artifical Light
natural ventilation
mechanical ventilation
Shading Devices
Universal Design
Fire Safety
Materials
Air Condition (Y/N/not mentioned)

Table 3. Keywords

Qualitative Evaluation	
+	Mentioned in report with detailed solution
~	Just mentioned
-	Not mentioned.

Table 4. Qualitative evaluation

3.3 Assumptions on Input-Data & Calculation Method

As the competition entries were depicted just in one poster and a short report, many projects did not feature sufficient input data for performing calculations of the heating demand or other numeric energetic performance indicators. To allow a certain level of assessment with a simple, common calculation method, at least basic thermal properties of all relevant building parts need to be defined. The authors made a set of assumptions on these basic properties (see Table 5): For existing building parts that were targeted for refurbishment, the U-Values were determined according to the minimum standards of the OIB Guideline Nr. 6 [OIB]. For new building elements, a set of thermal properties was defined that is far beyond the minimum requirements, although not as strict as the standard values for passive houses. These assumptions were based on the cost limit that was mentioned in the competition outline. Additionally, if pertinent dimensions were missing in the plans, the authors assumed that the glazing degree of outside walls was 50%.

	U-Values	
Building Element	Refurbishment	New buildings
Outside Walls	0,35 $W.m^{-2}.K^{-1}$	0,15 $W.m^{-2}.K^{-1}$
Flat Roofs	0,20 $W.m^{-2}.K^{-1}$	0,15 $W.m^{-2}.K^{-1}$
Earth adjacent floors	0,40 $W.m^{-2}.K^{-1}$	0,15 $W.m^{-2}.K^{-1}$
Windows	1,40 $W.m^{-2}.K^{-1}$ [g: 0,67]	1,00 $W.m^{-2}.K^{-1}$ [g: 0,67]

Table 5. U-Values

The calculation method used for derivation of the Heating Demand for each project was the Austrian Standards Method for Energy Certificates (Energieausweis), based on a set of Austrian Standards (ÖNORM 2011) and Guidelines [OIB]. The calculations were performed with the calculation software Archiphysik 9.1 (A-Null 2011).

4 RESULTS

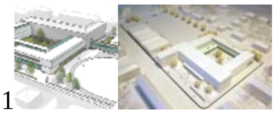
Jury Rank	Rank	Picture & Number	Keyword evaluation (max 24 points)	Heating Demand [kWh.m^{-2}.a^{-1}]	Characteristic length [m]
Rejected in Round 2	1	Project No 44 	22	34.48	2.16
Rejected in Round 1	2	Project No 40 	21	30.91	3.43
Rejected in Round 3	3	Project No 11 	18	24.37	3.51
Rejected in Round 1	3	Project No 13 	18	21.21	5.98
Rejected in Round 2	3	Project No 43 	18	30.49	3.04
Rejected in Round 1	6	Project No 28 	17	30.55	3.60
Award	6	Project No 54 	17	30.69	3.44
Award	6	Project No 60 	17	27.22	3.25
	[…]		*[…]*		
Award	14	Project No 07 	15	32.95	3.26
	[…]		*[…]*		
Award	34	Project No 24 	11	31.41	3.39
	[…]		*[…]*		
1 (Winner)	52	Project No 48 	4	29.73	3.23
	[…]		*[…]*		
2 (2nd)	56	Project No 08 	2	18.12	7.47
	[…]		*[…]*		
3 (3rd)	60	Project No 21 	1	37.36	2.86

Table 6 Evaluation of chosen projects

4.1 General Results.:

An overview of the results of the calculated projects, sorted according to points acquired in the keyword evaluation process, is presented in Table 6. In addition to the projects shown in this table, the authors evaluated also the existing building as is (referred to as BASIC) and after a potential refurbishment reaching the aforementioned U-Values (referred to as REFURBISHED), but without any change in the buildings or any annexes to existing building parts (both of these cases were based on a gross floor area of 10.082 m²). The Heating Demand of BASIC was about 108 kWh.m^{-2}.a^{-1} (or 1.091.762 kWh.a^{-1} for the whole complex) while REFURBISHED reached a Heating Demand of about 33 kWh.m^{-2}.a^{-1} (or 334.094 kWh.a^{-1}). Figures 1 and 2 show the comparison of heating demand of all selected projects. Figure 3 shows the Heating Demand of the selected projects as a function of the characteristic length.

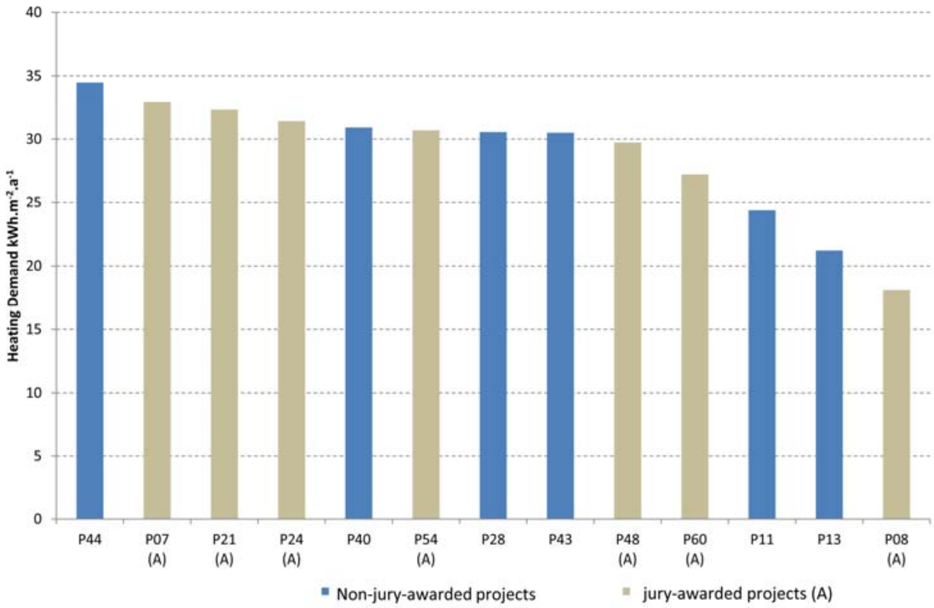


Figure 3. Heating demand in kWh.m^{-2}.a^{-1} of selected projects

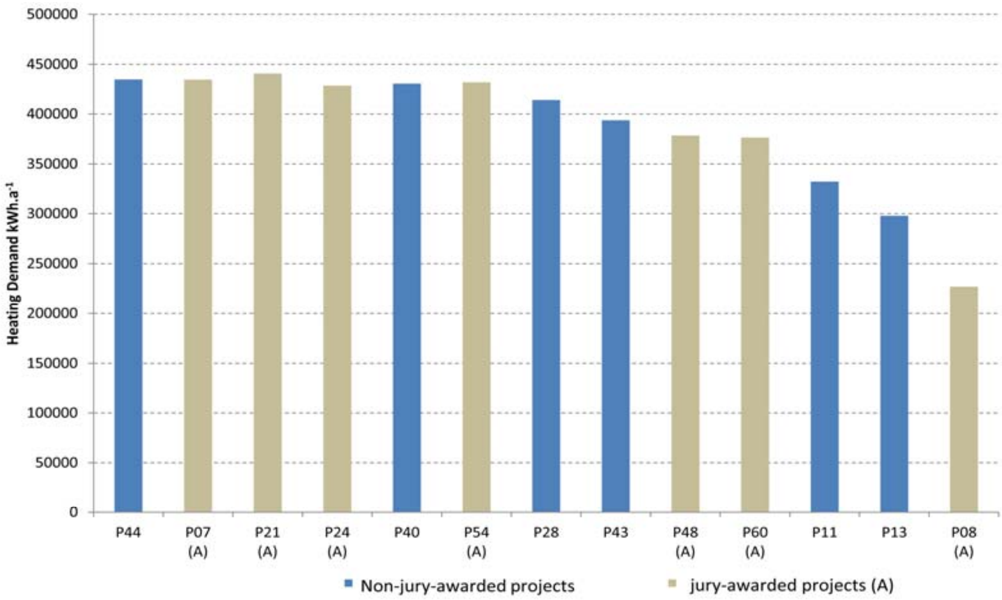


Figure 4. Heating demand in kWh.a^{-1} of selected projects

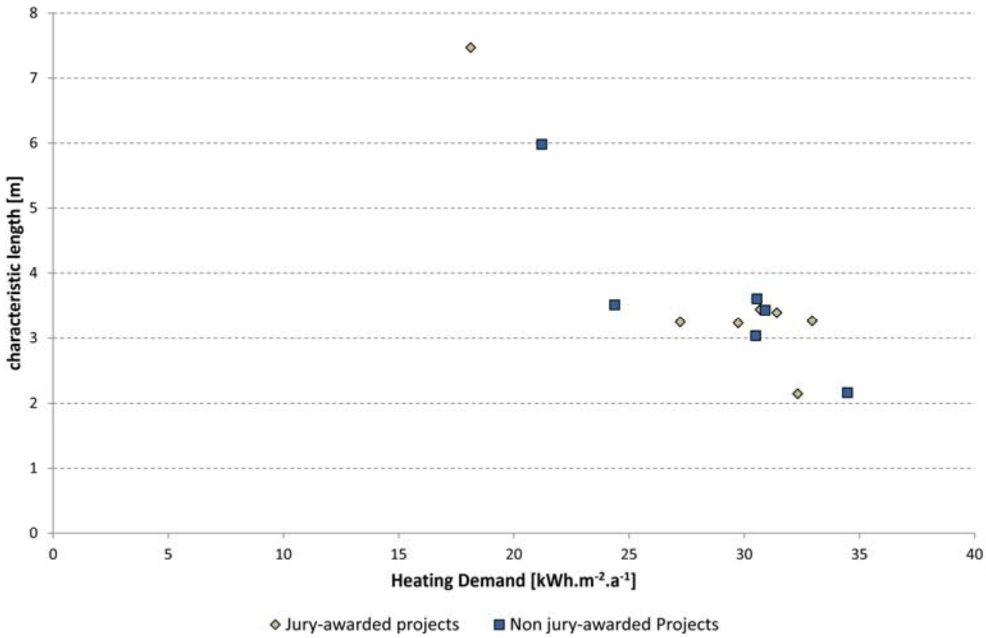


Figure 5. Heating Demand in kWh.m^{-2}.a^{-1} as function of the characteristic length

5 DISCUSSION AND CONCLUSION

5.1 General discussion

There is no clear relationship between the designs' calculated energy performance and either the Jury ranking or the key word ranking. Taking into account the values prescribed in the OISS-Guidelines [ÖISS], none of the depicted projects meets the requirements. These guidelines set the maximum Heating Demand for refurbished public buildings between 12 kWh.m^{-2}.a^{-1} (for buildings with high l_c values) and 25 kWh.m^{-2}.a^{-1} (for buildings with low l_c values). Although some of the projects feature a Heating Demand lower than 25 kWh.m^{-2}.a^{-1}, their requirements are according to their l_c value around 12 to 15 kWh.m^{-2}.a^{-1}. It has to be taken into account (see the category "uncertainties") that all calculations are based on input assumptions, and that further work on technical details of the winning project is expected by the client.

When taking into account the compactness of the building structures, most of the projects can be found in a point cloud (see Figure 3), whether jury-awarded or not. Some outliers show very high characteristic length (l_c value) and rather low heating demand. Those projects may perform very well from a thermal point of view, but should be evaluated carefully in terms of daylighting and natural ventilation.

Generally speaking, although the jury-awarded projects do not perform very well in view of the key word evaluation (based on project portfolios), there is little difference in the energy performance of projects regardless of them having been awarded by the Jury or not.

5.2 Uncertainties

As mentioned before, some of the input data used for calculations as well as the evaluation scheme deployed incorporate various assumptions pertaining to design data not available from the project submission documents. In detail, the empirical evaluation of the competition entries towards ecological criteria was based on the text published on posters and in short descriptions of the projects. Additionally, the competitors had the possibility to hand in folders with detailed descriptions of their design, thus some information could be found in those. Unfortunately, those folders never were published, and are therefore not accessible to the authors. This problem is put into perspective, if it is noted that the jury ranking was based solely on models and posters.

Moreover, many of the competition entries do not feature detailed information about the construction properties of their designs. Due to the small scale of plans, little information about constructive layers, thermal properties, glazing percentage or shading devices is included. It appears as if many architects did not specify certain aspects of their designs that would have been necessary for objective performance analysis. In this context, it must be noted that in many architectural practices the use of calculation or simulation methods for evaluation of building performance is not very common (Mahdavi et al. 2003). It is likely that, as long as it is not explicitly mandated, architects would not conduct detailed calculations for their project submissions due to time and cost constraints.

5.3 Future Research

As the heating demand only addresses one aspect of a building's performance, further investigations must include issues such as daylighting, life cycle of building components, overheating avoidance, and other relevant parameters. An implementation and testing of existing evaluation systems, as well as further developments in this area should be targeted. Moreover, further instances of architectural competitions should be studied. Such studies would aid those responsible for public procurements toward a more accountable process for the formulation and processing of architectural competitions that would result in eco-efficient buildings of the future.

5.4 Conclusion

The use of architectural competitions for achieving high quality designs of public, semi-public, and private buildings is a cornerstone of the European public procurement law (EU 2004). As the energetic performance, sustainability (LCA), and thermal comfort requirements grow in importance, public procurements are forced to implement these criteria in the formulations and also evaluation of competitions. While the calculation of certain indicators may be a possible way of defining “hard” criteria, a careful key word evaluation of the submission narratives may a complementary “soft” way of evaluating competition entries. Nonetheless, this paper's results indicate that there is a growing need for simple but effective ways to include the above mentioned criteria in the evaluation process for architectural competitions. It is necessary to avoid unnecessary burden for the participants in terms of time and workload, but on the other hand, these criteria need to be feasible, comprehensible, and workable for the jury.

6 REFERENCES

A-NULL BAUPHYSIK GMBH: ArchiPHYSIK 9.1 Edition Österreich, 2011

EU: 2004/18/EG EU-Vergaberichtlinie, Bruxelles, 2004

HAUSLADEN, Gerhard; RIEMER, Hana; DRITTENPREIS, Julia: Entwicklung eines energetischen und raumklimatischen Planungswerkzeugs für Architekten und Ingenieure in der Konzeptphase bei der Planung von Nichtwohngebäuden sowie Erstellung eines Anforderungs- und Berwertungskatalogs für Architekturwettbewerbe. Stuttgart (2010)

KLOOZ, Daniel; DELLENBACH, Stefan: Architekturwettbewerb im Zeichen nachhaltiger Entwicklung. Tec21 3-4 (2005)

MAHDAVI, A.; EL-BELLAHY, S.: Effort and effectiveness considerations in computational design evaluation: a case study, Building and Environment 40 (2005), Elsevier, available www.sciencedirect.com

MAHDAVI, A.;FEURER, S.; REDLEIN, A; SUTER, G: An inquiry into the building performance simulation tools usage by architects in Austria, 8th International IBPSA Conference, Eindhoven, The Netherlands; 11.08. - 14.08.2003; Building Simulation, p. 777 - 784. 2003

NEXT-PM Ziviltechniker GmbH: Auslobungsunterlagen Wettbewerb. Wien, 2011

NEXT-PM Ziviltechniker GmbH: Niederschrift über die Sitzung des Preisgerichts vom 06. und 07. Oktober 2011

ÖNORM: ÖNORMEN B 8110 Teil 1-6 and ÖNORMEN H 5050 – 5059, Wien, as of 2011

SIA: SNARC: Systematik zur Beurteilung der Nachhaltigkeit von Architekturprojekten für den Bereich Umwelt, Zürich (2004)

[ENERGY]: www.energy-design-guide.ch, checked on 22.03.2012

[ÖISS]: www.oeiss.at, checked on 22.03.2012

[OIB] Richtlinie 6: Energieeinsparung und Wärmeschutz, www.oib.or.at/RL6_061011.pdf, checked on 22.03.2012

[SOL]: www.solar-computer.de/, checked on 22.03.2012