



Presentations

Andrzej Kaczmarek*, Paweł Kirschke**

Zero net energy public library for the San Benito County in Hollister, CA

Author of the design: Andrzej Kaczmarek

Award: Merit Award in the international architectural competition Architecture at Zero 2020

Introduction

The design¹ by Andrzej Kaczmarek presented in this paper received a merit award in the “Architecture at Zero 2020” international architectural competition organised by the American Institute of Architects California² and PG & E³. This yearly competition is addressed to students and professional architects who face the same competition task, but are judged in separate categories. In 2020, the task was to design a zero net energy public library for the San Benito County, to be located in Hollister, California, USA. Two facets of the designs were judged, i.e. the first concerned architectural solutions while the second focused on technical matters and presenting the building’s

energy effectiveness strategies and systems. In the students category, the jury⁴ gave three merit awards and one honourable mention. The professional category had one honour award and two honourable mentions⁵.

Competition history

The “Architecture at Zero” competition has been organised since 2011 with the intent to pursue innovative architectural and technological solutions based on zero-energy concepts. The ideas, which the state of California sees as key, were published in *California’s Long Term Energy Efficiency Strategic Plan* by the California Public Utility Commission (CPUC) [4]. It features strategies that were aimed at ensuring that all new housing was to consist of zero-energy buildings by 2020, with the same

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¹ Andrzej Kaczmarek’s module design is also a Master’s thesis project prepared under the supervision of dr hab. inż. arch. Paweł Kirschke Professor PWr (Wrocław University of Science and Technology).

² AIA California is the largest state association of architects in the US. It was established in 1944. It has twenty-two local chapters all over California, which significantly affects how the design and construction sector develops in this region [1].

³ Pacific Gas and Electric Company [2].

⁴ Jury members: Gregg D. Ander, FAIA (Fellow of the American Institute of Architects), Marsha Maytum FAIA, LEED AP (Leadership in Energy and Environmental Design Accredited Professional) – Leddy Maytum Stacy Architects, Cole Roberts PE, LEED AP – Associate Principal | Energy & Resource Sustainability Arup, Paul Torcellini, PhD PE – Principal Engineer, National Renewable Energy Laboratory, Allison Grace Williams, FAIA – AGWms_studio.

⁵ The total awards pool in 2020 was USD25,000. The results of the competition have been published online at: [3].



Fig. 1. Visualization of the west-south side of the library
(elaborated by A. Kaczmarek)

II. 1. Wizualizacja: widok biblioteki od strony południowo-zachodniej
(oprac. A. Kaczmarek)



Fig. 2. Central internal atrium as a public space
(elaborated by A. Kaczmarek)

II. 2. Centralne atrium wewnętrzne jako przestrzeń publiczna
(oprac. A. Kaczmarek)

applying to all commercial buildings by 2030. The competition is to educate designers and users by familiarising them with the precepts and systems of sustainable design. Due to its international character and the participation of numerous design teams from America, Europe and Asia, the competition is internationally recognised. The year 2020 was the first time that a library became the competition's main focus. In previous editions, participants had to design, among other things, a student recreation centre for the California State University, a complex of students dormitories for this university, or an education centre for the Estuary and Ocean Science Center in Tiburon.

Since 2011, the organisers have been conducting research intended to verify the effectiveness of the competition based on four main criteria such as the engagement of the final addressee in the design process, educating competition participants on zero net energy design (ZNE) and practices, presenting how these practices should evolve and motivate competitors to include precepts of sustainable design in actual construction projects. The assessment team interviewed jurors, participants and competition management personnel and performed in-depth analyses. Furthermore, a review of the literature and online sources concerning zero net energy design was performed. The conclusions confirmed that the competition was rated very positively by all interested parties and can significantly contribute to raising awareness of sustainable design among designers⁶.

Competition task for 2020

The theme of the last edition of the competition was the design of an energy-optimised public library for the San Benito county, to be located in Hollister, CA. Its objective was to create a new building (replacing the existing one) that would significantly increase the usable floor area of the library and provide many new activity opportunities for local residents. The town of Hollister is located in central California and is a part of the Monterey Bay

Area. The proximity of Silicon Valley means that it is an attractive place to live. The construction of a new public library building is much needed by the local community due to the dynamic development of the region and the lack of a clearly defined meeting place for local citizens. The competition task was an urban-planning challenge due to the building's highly extensive functional programme, a low maximum building footprint and the low height of the surrounding commercial and residential buildings. Another difficulty the participants had to face was the need to account for the seismic activity at the site.

Over 150 submissions from all over the world entered the competition. In the professionals category, the design called *The Book Garden* by Jensen Architects from San Francisco was rated the highest⁷. The jury decided that it met all the goals of the competition and was an excellent fit for a place like Hollister. The architects designed a building divided into several cascading masses that was also embedded into the ground up to a height of one storey, which allowed for a significant increase of its volume and creating the required formal character. Due to these measures, combined with the use of large glazed surfaces and a timber structural system, a friendly space with a human scale could be created. Due to an inventive interior layout, the space of the library was naturally divided into zones. All these qualities, when combined with greenery, created an attractive place for gatherings, peace and quiet, as well as learning and entertainment. In the students category, merit awards were also given to teams from Ankara⁸ and Ahmedabad⁹. The team from Turkey, in its design entitled *To Gather*, presented a dynamic form of a building rotated by 20° relative to the surrounding pre-existing buildings,

⁷ This design firm specialises in pro-environmental designs. Their website states that their main objective is: "to create buildings and environments in dialogue with culture and place" [6].

⁸ Members: Şükran Yavuz, Gülsu Ulukavak Harputlugil, Timuçin Harputlugil, Çiğdem Yılmaz, Yousef Daneshvar Rouyandozagh, Başak Kalfa, Mete Sezer, Sueda Kabak – Kankaya University, Ankara, Turkey [3].

⁹ Members: Amanda Santiago, Abraham Philip, Het Modi, Sejal Shanbhag, Shubham Solanki, Stuti Goyal, Uma P, Urvi Shah, Vardan Soi, Rajan Rawal – CEPT University, Ahmedabad, India [3].

⁶ A report on this study is available on the organiser's website: [5].

creating highly diverse common spaces. The design's main strengths were: allowing people to freely walk underneath the building using external stairs, a system of internal galleries, light form of the building's openwork facade and the skilful design of space for natural ventilation. The design entitled *Meraki* by a team from India largely focused on the landscape of Hollister, the ability to observe it from the library building and the maximum amount of energy that could be generated using photovoltaic panels. The building itself was designed to be suspended above the terrain, providing access to the museum and auditorium from ground-floor level. This solution enabled the creation of a green recreational space for residents and an oval atrium that could aid in ventilation and ensure that natural light could enter the building's internal spaces. An additional honourable mention was given to a multi-person team from two universities based in San Francisco and Taiwan¹⁰.

ZNE context

Since 2008, the design of zero net energy buildings in California has been legally codified by state institutions, making it no longer a matter of choice for designers, but instead a means of pursuing a specific goal. This way, California has outlined a certain development trajectory that is also followed by other countries and regions. The school library in Atherton by WRNS Studio¹¹ is a very good example of a California building that meets all the criteria of a zero net energy building. The library is the centre of a larger campus that also comprises a primary school and a high school. The design of the entire building is highly symbolic and has educational significance for the youth. The values of sustainable development that are promoted here are communicated to students not only through books, but primarily via the surrounding architecture. To achieve this, it became the primary goal to demonstrate how proper building design and everyday activities contribute to better environmental protection and resource management. The building makes use of numerous eco-friendly solutions such as maximum access to daylight, the use of locally sourced materials, natural and displacement ventilation, storm-water storage, the use of photovoltaic panels and a grey-water treatment system. The building produces twice as much energy as it consumes and holds NZEB¹² and LEED Platinum certificates¹³. For over a decade, the promotion of sustainable architecture has been reflected not only in social services buildings, but also in A-class commercial office buildings for which these certificates are obligatory. At present, there is an unprecedented demand for sustainable buildings all over the world, motivated by their

performance, eco-friendliness and a belief that certified buildings reach the break-even point quicker than conventional buildings¹⁴.

Design:

Atrial Creep – functional solutions and form

The design by Andrzej Kaczmarek was presented under the title *Atrial Creep* and was prepared following the competition's detailed guidelines. The building's programme assumed creating a library equipped with accompanying functions such as meeting halls, an auditorium for an audience of 400 or an office section. The library was also designed to feature a seminar zone for children and adults. The main idea behind the design was based on the maximum use of natural climate characteristics while accounting for the seismic activity present at the site. When designing the development and functional layout, it became key to thoroughly analyse the needs of local citizens and the surrounding urban tissue (fabric). The library building was to be sited in the central part of Hollister, close to the historical Monterey Street, which is characterised by a variety and wealth of styles, on the border of a services complex and single-family housing complex of varying height. The well-defined borders and the orthogonal street grid typical of American cities enhanced the integrity of the district. The block with the project site comprises formal public administration buildings, which determined the suitable form of the building while also maintaining the friendly character of a city library. The demographic context proved essential to the design process. With a population of almost 37,000, Latinos make up 67.4% of Hollister's citizens, and the average age is over five years lower than the national average. The proximity of Silicon Valley also means that median household income is much higher than the state and national averages. These elements contributed to designing a building intended to primarily attract young people with high expectations concerning the space they are present in (Figs. 1–3)¹⁵.

The entire process of designing the building began by adapting the functional programme proposed by the organisers to the surrounding urban tissue and the project site. The first stage was a building line analysis and a decision to set back the library massing deeper into the plot while also increasing the distance between buildings which brought greater order to the urban layout and improved the composition. The next step was to harmoniously adapt the height of the building to the surrounding development, which entailed placing one of the library's storeys underground, at a depth of 6 m below grade. This resulted in a building that referenced the surrounding development with its scale while also retaining its formal character. It also introduced an element of surprise, as users would encounter a much more spacious and open

¹⁰ These were: Academy of Art University San Francisco and Chung Yuan Christian University Taiwan.

¹¹ Sacred Heart Schools Stevens Net Zero Library: [7].

¹² Net-Zero Energy Building.

¹³ Leadership in Energy and Environmental Design – it is possible to achieve one of four certification levels: Platinum, Gold, Silver, Certified.

¹⁴ The certification of services buildings and the phenomenon of the green premium have been discussed in: [8], [9].

¹⁵ Demographic data for 2018 [10].

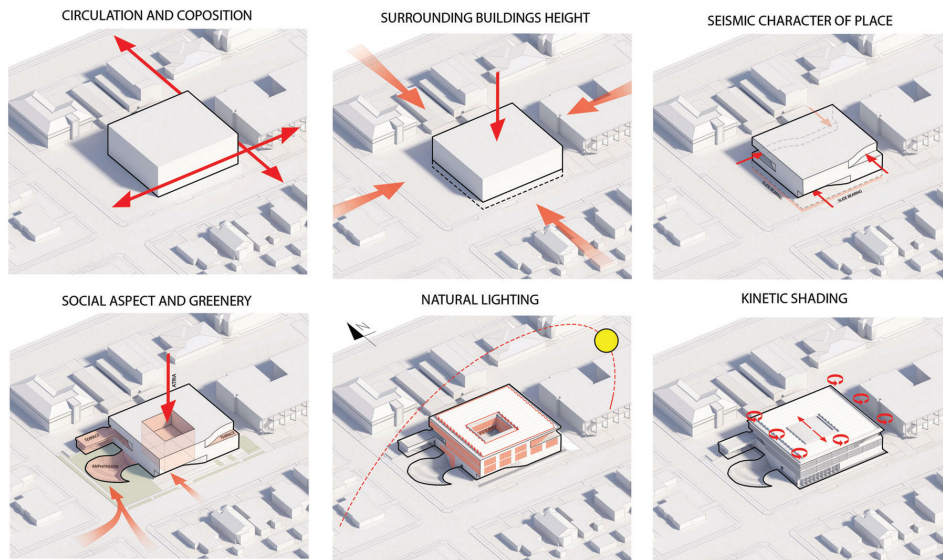


Fig. 3. Design diagrams and development of the building concept (elaborated by A. Kaczmarek)

Il. 3. Schematy pokazujące rozwój koncepcji budynku (oprac. A. Kaczmarek)

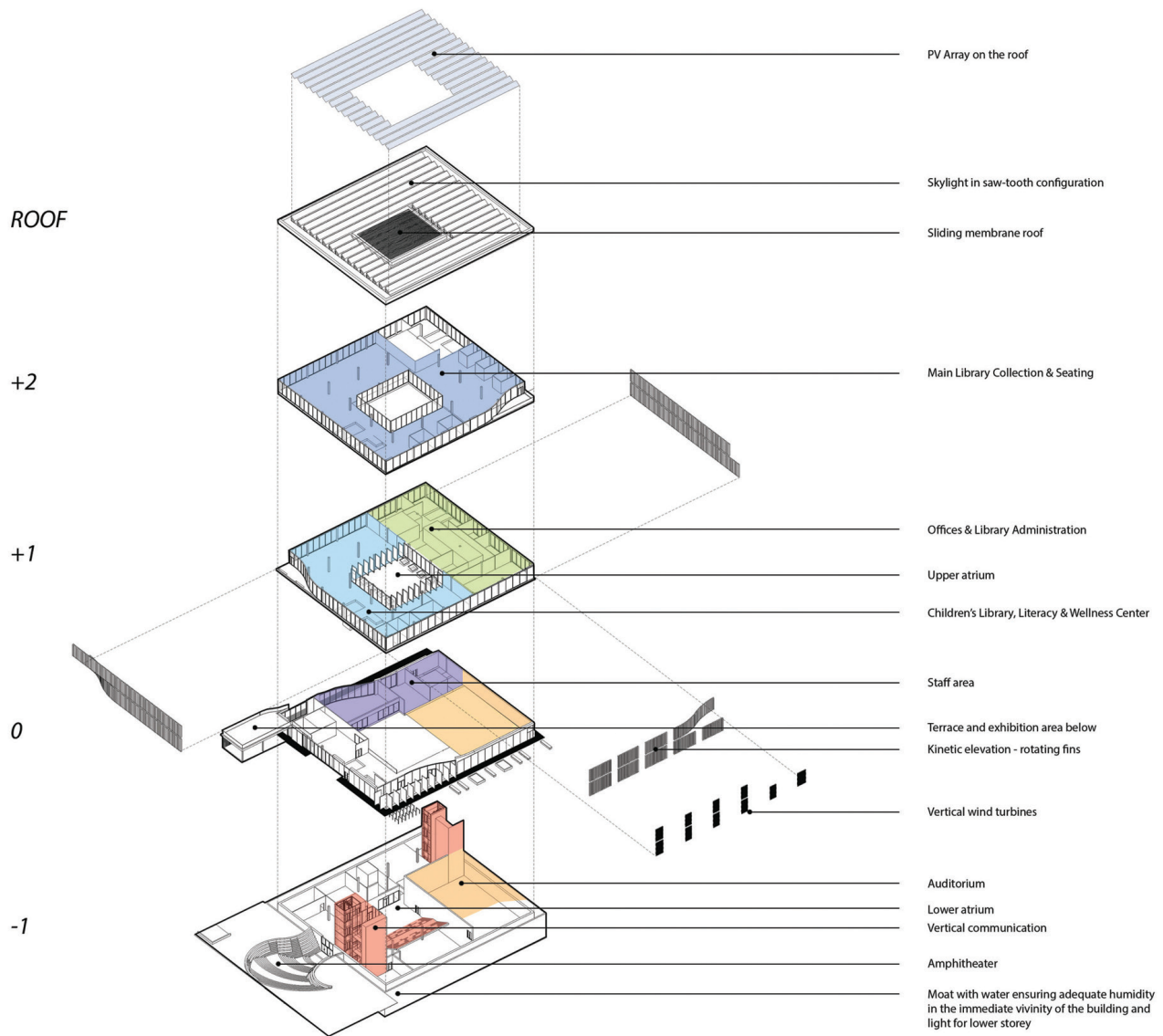


Fig. 4. Axonometry and functional zoning (elaborated by A. Kaczmarek)

Il. 4. Aksonometria i strefowanie funkcji (oprac. A. Kaczmarek)

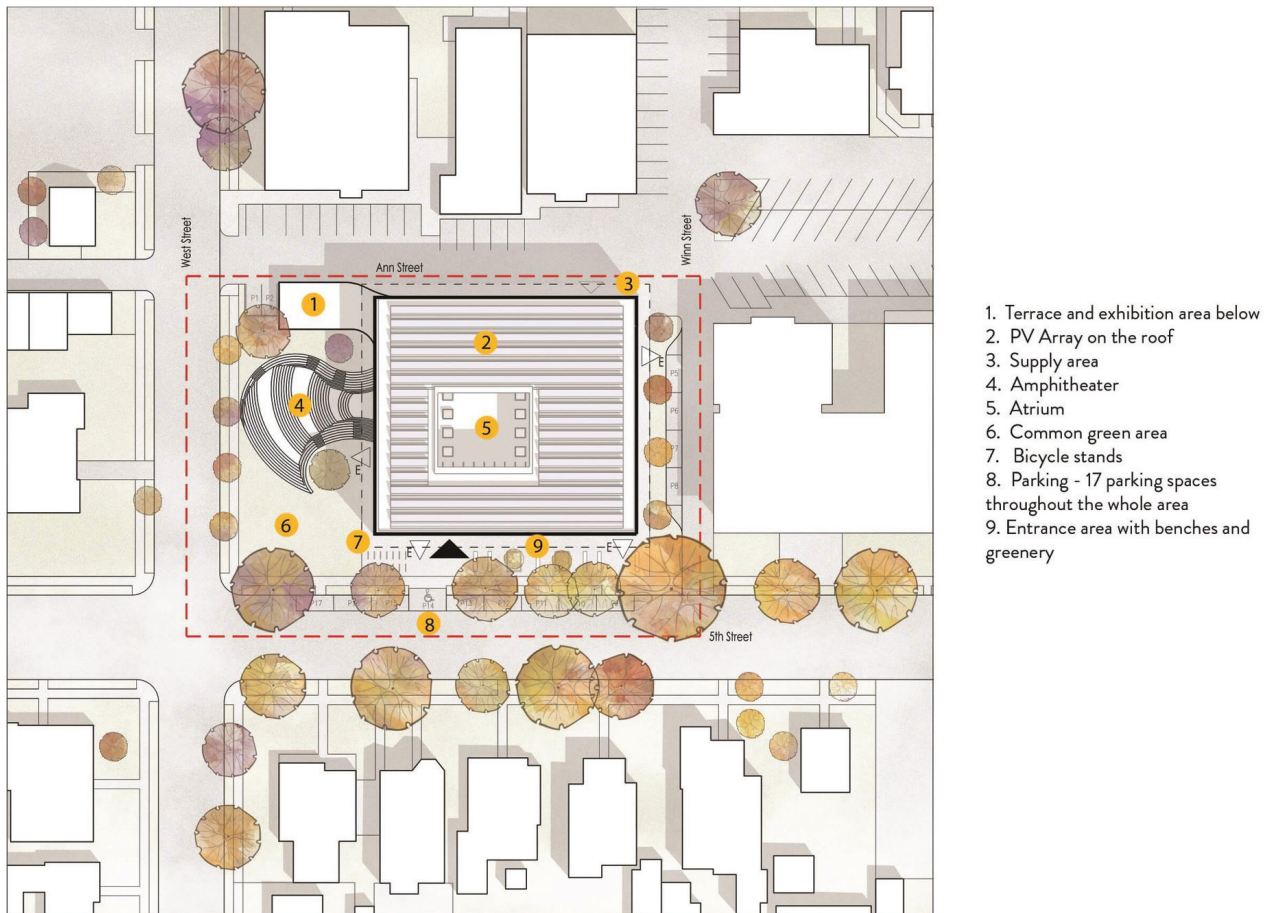


Fig. 5. Site plan with development solutions (elaborated by A. Kaczmarek)

II. 5. Projekt zagospodarowania terenu (oprac. A. Kaczmarek)

interior than they could otherwise expect. Due to the entire area being seismically active, the building was designed to have a suitable structural system and footing supported by seismic isolators that minimise forces that act upon its structural system and the risk of damage¹⁶. Earthquakes and aseismic creep¹⁷ were also inspirations for the building's form, which, through the fluid change of shape, forms an entrance zone and a system of terraces. One of the key elements of the library are common areas, tasked with providing local citizens with a pleasant place to meet and spend their free time in. This was achieved by two central internal atriums, one above the other, an open rooftop exhibition pavilion with a terrace, and an amphitheatre that connects the entrance zone on the ground floor with an underground storey with services. The building has many meeting halls, including an auditorium for just short of 400 people. Another important aspect was the daylighting of internal spaces, which is crucial in any library. Skylights and glazings in the north-facing façade were used for this purpose. The remaining façades have less glazing relative to their overall surface and were

designed to feature kinetic façade systems in the form of computer-controlled panels that automatically regulate interior daylighting. Materials that reference the history and resources of central California are another crucial element of the building's form. Colonial-mission-era architecture that was one of the inspirations for the design is characterised by irregular white plaster [13], which, when combined with the local cream-coloured Monterey slate that is colloquially called Carmel Stone, forms a very simple and pleasing visual combination (Figs. 4, 5).

The designer tried to create a clear and intuitive functional layout. The building is composed of four storeys, including one storey below grade, interconnected by two stairwells and three lifts. The main entrance is located from the south, in a recessed section that opens and closes via rotary wall panels. A service entrance and the building's delivery section were placed in the northern side. The main hall provides access to the book circulation service and to a wide set of stairs with seats that connect the ground floor with level -1. This is the area that acts as one of the building's multi-functional meeting spaces, as well as a foyer for a large auditorium and a smaller meeting hall. Another attraction is the building's external amphitheatre, linked with an entrance to the hall at level -1, which houses a coffee shop, passport office and an interactive historical museum relocated from the

¹⁶ Seismic isolators are made from rubber laminate and a core that stabilise the building during an earthquake: [11].

¹⁷ Aseismic creep is a surface shift produced by tectonic movement yet without an earthquake present [12].



Fig. 6. Floor plans of the library (elaborated by A. Kaczmarek)

II. 6. Rzuty kondygnacji projektowanej biblioteki (oprac. A. Kaczmarek)

Wapple House¹⁸. The entire floor is illuminated via skylights above the atrium and a moat that surrounds the building. The first floor is divided into two parts. The first is an office space that is to house the library administration, as well as office spaces for rent. The second part is a children's library and a centre for learning reading and writing, and a workshop centre. The functional layout is highly flexible due to movable walls and a kinetic atrium façade. When necessary, it would be possible to cover the atrium with a sliding membrane roof, which (similarly to the entire roof) is adapted to collecting stormwater. Users would also be given access to a spacious west-facing terrace, placed above the pavilion for temporary exhibitions.

¹⁸ The small Wapple House that is located on the site, designed in 1909 by well-known architect Frank Delos Wolfe, was assigned for relocation. Since 1974, the building has housed the San Benito County Historical Society. The competition guidelines required that the museum's contents were to be relocated into the new library [14].

The second floor was designed to have a completely open layout that would house the remaining part of the library collection and most of the workstations. Due to the use of a kinetic façade and saw-tooth skylights, the entire space could be illuminated with scattered light that provides ideal conditions for studying and working (Fig. 6).

Design:
Atrial Creep – ZNE solutions and calculations

The zero-energy aspect of the building considerably affected the form and functional solutions of the library. By following the triad of sustainable development, i.e., economy, ecology and society, which directly carry over to the utility, durability and beauty of the building¹⁹, the

¹⁹ A manner of describing the conditions of sustainable development as presented in [15].

designer tried to create a building that would meet the expectations of local citizens, be self-sufficient and would blend in well with its setting. The analysis of the climate of this part of California proved key. The warm Mediterranean climate present here requires the massing and façade

structure of the building to be shaped in a proper manner so as to provide good ventilation and shade while also not being exceedingly fragmented, so as to limit heat loss during winter. The compact, cubic form proposed in the design, with an internal atrium fitted with a sliding mem-



Fig. 7. Bird's eye view visualization (elaborated by A. Kaczmarek)

Il. 7. Wizualizacja: widok z lotu ptaka (oprac. A. Kaczmarek)

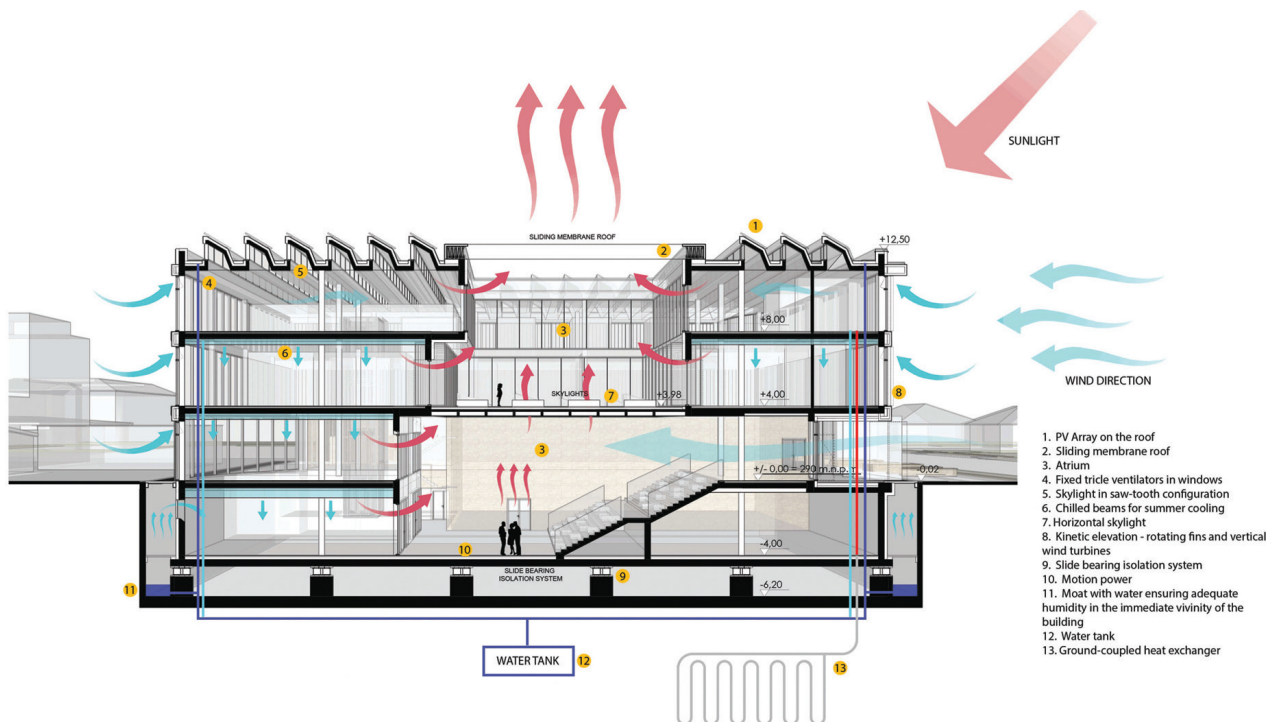
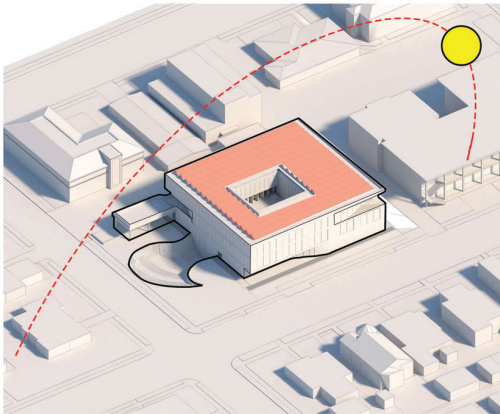


Fig. 8. Graphic section and air circulation process (elaborated by A. Kaczmarek)

Il. 8. Przekrój graficzny przedstawiający cyrkulację powietrza w obiekcie (oprac. A. Kaczmarek)

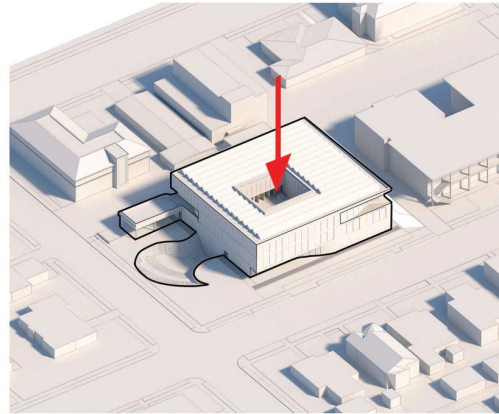
SOLAR ENERGY



Due to very favorable weather conditions and an average of 266 sunny days per year, solar energy is a natural source of electricity. Solar panels roofed towards the south generate the majority of energy for the building. All energy can be stored in a battery in a building.

PV panels can generate 324,107 kWh per year
 DC System size: 154kW
 Module type: Premium

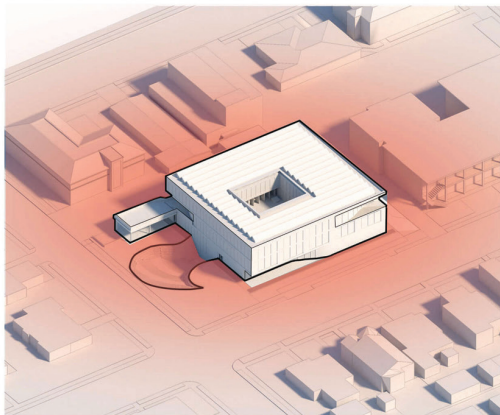
ENERGY OF MOVEMENT



Walking people can generate energy during the day in the most occupied area: atrium and stairs. The way to get this energy is the Pavegen System of triangle tiles on micro-inverters.

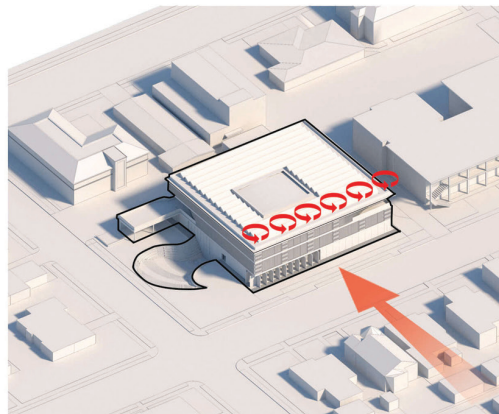
That kinetic energy harvesting provide 4,500 kWh per year.

GEOTHERMAL ENERGY



Geothermal energy is a great opportunity to get solution for heating a building and regulating the temperature of the space. Building uses ground-coupled heat exchanger.

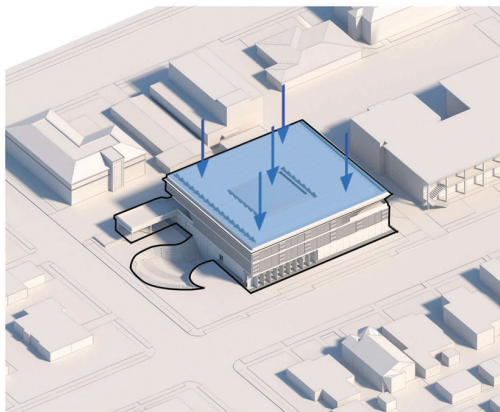
WIND ENERGY



The southern wind prevails in the area, which prompted us to design vertical wind turbines that harmoniously connect with the rest of the facade.

Wind turbines can generate 2,803 kWh per year

WATER COLLECTION



In the Hollister area, most of the rain falls in the middle of the year from November to March. Due to water shortages, storage and use rain water in the everyday operation of a building is very important. Water is collected in graywater cistern under the building.

The average annual rainfall is 13.85 inches.

Annual water collection is 15 347 Gallons

VEGETATION



Greenery plays a very important role in the good functioning of public space. The terrace system and the amphitheater surrounded by greenery provide a very pleasant atmosphere and ideal conditions for meetings of local residents. Pedestrian routes have been highlighted with rows of trees, and public spaces have been properly developed.

Fig. 9. Design diagrams of sustainability solutions in the building (elaborated by A. Kaczmarek)
 Il. 9. Schematy rozwiązań zrównoważonych dla projektowanego budynku (oprac. A. Kaczmarek)

ENERGY MODEL

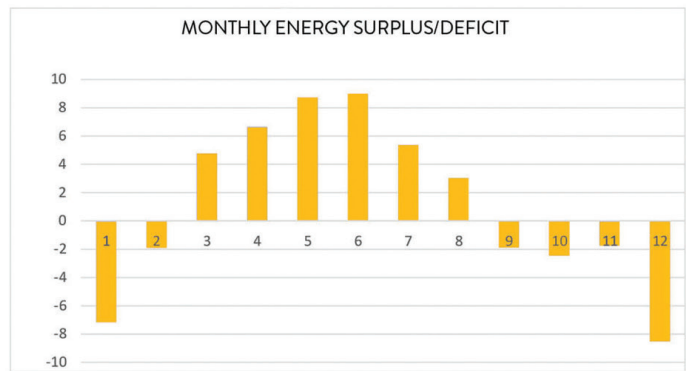
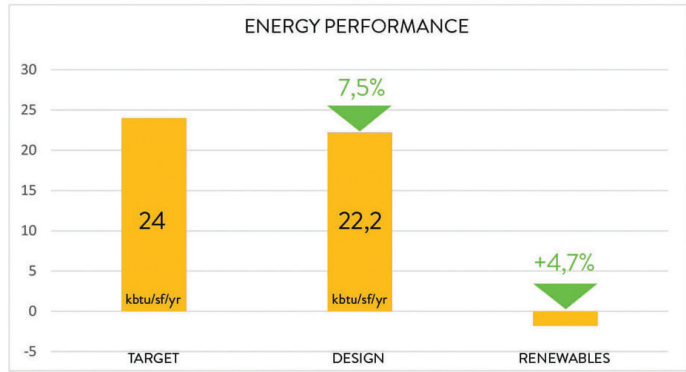
Annual Energy Consumption: **292,760 kWh/yr**
 Annual Energy Generation: **306,616 kWh/yr**
 -PV Panels: 299,313 kWh/yr
 -Wind Turbines: 2,803 kWh/yr
 -Kinetic Energy: 4,500 kWh/yr

EUI = 70 kWh/m2/yr = **22,2 kbtu/sf/yr**

The thermal energy demand is partly replaced by geothermal heat. The amount of cooling energy needed is probably exaggerated because of the very good natural air circulation. We use **eQUEST 3-64** as a simulation tool.

Design systems:

- Very good natural ventilation assisted by chilled beams;
- Ground-coupled heat exchanger;
- Geothermal Energy;
- Daylighting - using skylights and windows to reducing need for electric lights;
- LED lighting;

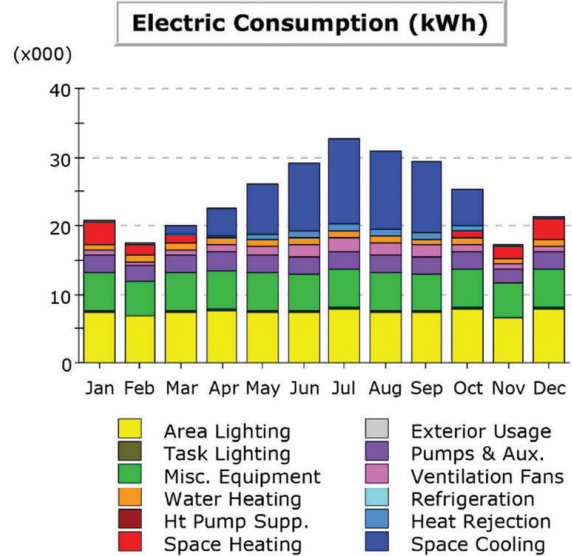


RESULTS

299,313 kWh/Year*

System output may range from 284,258 to 306,197 kWh per year near this location.

Month	Solar Radiation (kWh / m ² / day)	AC Energy (kWh)	Value (\$)
January	3,40	13,102	2,043
February	4,32	15,064	2,348
March	6,35	24,172	3,768
April	7,86	28,497	4,443
May	9,31	34,292	5,346
June	10,50	37,481	5,843
July	10,32	37,300	5,815
August	9,29	33,348	5,199
September	7,69	26,859	4,187
October	5,96	22,303	3,477
November	4,06	14,864	2,317
December	3,11	12,032	1,876
Annual	6,85	299,314	\$ 46,662



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	1,32	3,97	7,48	9,95	12,20	11,45	10,34	5,54	-	-	62,25
Heat Reject.	0,09	0,15	0,21	0,36	0,72	0,95	1,18	1,09	0,99	0,66	0,16	0,12	6,68
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	3,45	1,73	1,06	-	-	-	-	-	-	0,95	1,88	3,09	12,16
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	1,00	0,91	1,00	1,03	0,95	0,90	0,90	0,85	0,84	0,90	0,80	1,00	11,07
Vent. Fans	0,71	0,64	0,78	1,02	1,38	1,76	2,05	1,90	1,67	1,09	0,61	0,74	14,34
Pumps & Aux.	2,55	2,31	2,55	2,67	2,55	2,55	2,67	2,55	2,55	2,67	2,19	2,67	30,48
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	5,40	4,89	5,40	5,47	5,40	5,33	5,55	5,40	5,33	5,55	4,90	5,55	64,17
Task Lights	0,25	0,22	0,25	0,26	0,25	0,25	0,26	0,25	0,25	0,26	0,21	0,26	2,96
Area Lights	7,43	6,72	7,43	7,70	7,43	7,40	7,74	7,43	7,40	7,74	6,48	7,74	88,66
Total	20,88	17,58	20,01	22,47	26,16	29,09	32,55	30,92	29,36	25,36	17,22	21,16	292,76

Fig. 10. Analysis of energy consumption and generation (elaborated by A. Kaczmarek)

II. 10. Analiza energetyczna zysków i strat ciepła (oprac. A. Kaczmarek)

brane roof, meets all of these criteria, maximising access to natural light and allowing for the design of additional open spaces²⁰. Wind direction analysis resulted in optimal gravitational ventilation solutions. The two-storey atrium was designed to facilitate natural air circulation, which, when combined with an automatic window opening system, allows for saving a considerable amount of energy that is required for standard mechanical ventilation. Indoor temperature is regulated with a ground heat exchanger, cooling beams in some rooms and a system of heat pumps that utilise geothermal energy. Furthermore, the use of triple-glazed windows in façades and the elimination of thermal bridges in the building limits the impact of significant temperature changes that can happen during the day. Another key aspect is stormwater storage. The building was designed to collect stormwater from the entire roof surface and store it in an underground tank. A part of it would also be used to fill up the moat around the building, improving microclimate and air humidity in the immediate vicinity of the library via evaporation. This water can also be used in the building as greywater for watering plants, which play a key role in shading and improving the quality of public spaces designed near the building (Figs. 7, 8).

To achieve a zero net energy status, a building must have not only a minimum yearly energy consumption, but must also produce it itself. Climate analysis determined the choice of energy generation system. The general area of Hollister has an average of 266 sunny days per year²¹, which enables effective use of natural sunlight as an energy source. The building's orientation and saw-tooth roof were not accidental. Photovoltaic systems are the most common form of energy generation for buildings and are the most cost-effective in terms of price, surface requirements and performance. Photovoltaic panels located on the roof account for over 97% of the energy produced by the building. The entire battery system is oriented southwards and was designed to be fitted to the roof's surfaces, whose slopes were adapted to its needs thereby making it unnecessary to build specialist support structures and allowing for a simplification of the assembly system²². Due to employing an attic wall and setting the entire installation back from the roof edge, the latter would be invisible from the ground-level. Wind and motion were to be equally important in the design. Sixty-seven small, vertical wind turbines with a power output of 2,800 kWh/yr were designed on the southern facade. The energy produced by the users when moving around the library would also be used in the most frequently visited part of the building, the atrium, where the design features a Pavegen²³ floor that

converts vibrations produced by human movement into electrical energy (4,500 kWh/yr). In summary, it should be stated that the sources listed above could be used to produce 306,616 kWh/a of energy, while the building would have an energy demand of 292,760 kWh/a, resulting in a yearly net energy gain of 4.7%. Of course, energy demand and production rates would change from month to month, which is why a greater surplus would be observed during summer, while in winter a deficit would be possible. All calculations and simulations were performed using eQuest 3-64 software²⁴. The calculations showed that the building achieved the EUI²⁵ level assumed by the organisers, which was 24 kBtu/sf/yr. The library presented in this paper reached a value of 22.2 kBtu/sf/yr (70 kWh/m²/yr), which means an improvement of the expected energy use intensity by 7.5% (Figs. 9, 10).

Conclusions

Atrial Creep by Andrzej Kaczmarek was recognised by the competition jury primarily because it demonstrated an in-depth understanding of local place-based character and citizen needs. It met all assumptions in a rational and well-balanced manner while having a modest form. This is important as many architectural competitions see recognition being given to designs of buildings that dominate their surroundings, with flamboyant forms that constitute the so-called architecture of spectacle²⁶. In this case, it was an attempt at a balanced approach to design and the problems that accompany it. California is a world leader in terms of applying the precepts of sustainable development and this is a very good trajectory that spreads due to the wide-ranging training of designers, contractors and educating all of society. At present, in an era of climate crisis and plans made by the European Union concerning a European Green Deal that is to transform Europe into the world's first climate-neutral continent²⁷, it is beneficial to popularise sustainable development and zero net energy buildings in Poland. This requires proper legal regulations by the central government and municipal financial incentives, an informed society and years of joint work by scientists and engineers from many fields. However, it is worth engaging in these efforts to contribute to the prevention of the destruction of the natural environment and climate catastrophe²⁸ by designing zero net energy buildings that are also architecturally attractive and comfortable in use.

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²⁰ Analysis of form conditions relative to the climate and building use as per [16].

²¹ Climate data for 2016 [17].

²² Detailed information about technical solutions and technologies provided in: [18].

²³ Pavegen is a global leader in converting human motion into energy and in supplying data on this subject. Its proprietary installation is formed from triangular tiles connected to a vibration absorber that can produce up to 5 W of energy from every step [19].

²⁴ The software is free to download from: [20].

²⁵ Energy Use Intensity [21].

²⁶ This phenomenon has been discussed in: [22].

²⁷ Announced in 2020, the European Green Deal assumes that the content shall become independent of natural resources and shall achieve a greenhouse gas emission rate of zero by 2050 [23].

²⁸ A 2019 report by the Intergovernmental Panel on Climate Change (IPCC) demonstrated that all feedback loop parameters that lead to worsening global warming had been rising [24].

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Abstract

Zero net energy public library for the San Benito County in Hollister, CA

The objective of this paper is to demonstrate the use of elements of sustainable design in public buildings in the context of contemporary architectural design solutions and zero-energy standards for newly designed buildings in California, USA. The paper presents a detailed overview of the main task of the "Architecture at Zero 2020" international architectural competition, organised by the American Institute of Architects California – a design of the San Benito County Public Library in Hollister, CA. The paper also features a detailed analysis of the competition's outcome, with a specific focus on Andrzej Kaczmarek's design, which was given the merit award in the competition's student projects category. The competition resulted in the presentation of the library's design alternatives, each suited to context-specific environmental and climate determinants and optimised in terms of energy. Andrzej Kaczmarek's design met these requirements, as demonstrated via calculations performed using eQuest 3–64 software. The design was recognised not only because of its optimised energy balance, but also the excellence with which it satisfied the needs of local citizens and how it reflected a thorough understanding of the site's place-based character. The library was successfully blended in with its historical context via its simple form that was partially embedded underground. The building was designed to feature an array of advanced engineering solutions intended to secure it against earthquakes and optimise its heat balance, including kinetic façades and retractable glazed roof elements, photovoltaic panels, wind turbines and Pavegen floor surfaces.

Key words: Zero Net Energy Architecture, public library, San Benito, CA

Streszczenie

Zeroenergetyczna biblioteka publiczna hrabstwa San Benito w Hollister (Kalifornia)

Celem artykułu było ukazanie sposobów wykorzystania elementów projektowania zrównoważonego we współczesnych budynkach użyteczności publicznej, w kontekście architektonicznych rozwiązań projektowych i standardów zeroenergetycznych przewidzianych dla nowo projektowanych budynków w Kalifornii. Przedmiotem szczegółowych prac był projekt biblioteki publicznej hrabstwa San Benito w Hollister w Kalifornii, stanowiący zadanie w międzynarodowym konkursie architektonicznym „Architecture at Zero 2020”, organizowanym przez American Institute of Architects California. W artykule przeanalizowano wyniki tego konkursu, a w szczególności projekt autorstwa Andrzeja Kaczmarka, który zdobył równorzędną nagrodę w kategorii prac studenckich. Efektem konkursu było uzyskanie alternatywnych rozwiązań biblioteki dopasowanych do uwarunkowań środowiska naturalnego i klimatu, a przede wszystkim zoptymalizowanych pod względem energetycznym. Projekt Andrzeja Kaczmarka spełnił jego wymagania, co wykazano, przeprowadzając obliczenia za pomocą programu eQuest 3-64. Projekt ten został nagrodzony nie tylko za zoptymalizowanie bilansu energetycznego, ale również za znakomite spełnienie potrzeb mieszkańców i zrozumienie charakteru miejsca. Dobre wkomponowanie biblioteki w historyczne otoczenie uzyskano, nadając budynkowi prostą formę i zagłębiając go częściowo pod ziemię. W obiekcie zastosowano wiele zaawansowanych rozwiązań technicznych mających na celu zabezpieczenie budowli przed trzęsieniami ziemi i prowadzących do optymalizacji bilansu ciepła, w tym: kinetyczne fasady i ruchome oszklone dachy, panele fotowoltaiczne, turbiny wiatrowe i posadzki typu Pavegen.

Słowa kluczowe: architektura zeroenergetyczna, biblioteka publiczna, San Benito, Kalifornia



Swiss Museum of Transport, Lucerne,
(arch. Annette Gigon / Mike Guyer,
Architekten, Zürich,
photo by M. Brzezicki)

Swiss Museum of Transport, Lucerna,
(arch. Annette Gigon / Mike Guyer,
Architekten, Zürich, fot. M. Brzezicki)