Evaluation ENERBUILD-Tool – Building in planning phase

Annex Wing Triemli Hospital Zürich



[Pictures from Stadt Zürich – Amt für Hochbauten]

1 Basic information about the building

Name of the building	Stadtspital Triemli – Neubau Bettenhaus
Address of the building	Birmensdorfer Strasse 497, CH-8063 Zürich
Owner/investor	Stadt Zürich, Amt für Hochbauten
Year of construction	2008-2015
Building type	New hospital building at 460m a.s.l.
Building method	Massive construction
Number of buildings	1 (annex wing to existing building)
Number of levels above earth	15
Number of levels underground	2
Kind of the public use	City hospital
Effective area for public use in m ² (net)	ca. 900 m^2 restaurant/ guest areas ca. 29’000 m^2 patient stations
Additional private uses	-
Effective area for medical use in m ² (net)	ca. 19’400 m^2 medical stations and facilities
Total effective area in m ²	ca. 49’300 m^2
Source of energy for heating	Thermal ground probe with heat pump and biomass (wood) boiler; emergency backup with gas/ oil (biomass, gas/oil backup are also supplying steam for hygienic applications)
Heating system	Thermal ground probe with heat pump (80%, also used for cooling) and biomass (wood) boiler (20%)
Water heating system	Heat pump (100%)
Date of the building evaluation	2010/2011

2 Execution of the building evaluation with the ENERBBUILD tool

Responsible Organisation: Lucerne University of Applied Sciences and Arts – Lucerne School of Engineering and Architecture – Competence Center Topology & Foresight Planning in Architecture, Technikumstrasse 21, CH-6048 Horw, Contact person: C.Lars Schuchert

Telephone: +41 41 349 34 96 Email: lars.schuchert@hslu.ch

Temperature for thermal comfort in summertime: 25°C, the standard room temperature is adjusted to 22°C for hospital buildings according to Swiss SIA 380/1:2009, 3.5.1.2.

Local limits for heating demand: in Switzerland, the local limit for the heating demand is determined by the building's location (mean annual temperature), the building surface-to-heated floor area ratio, and its use. Also the limit differs according to the energy standard. Since the treaded floor area is calculated differently and the basic data is also taken into account differently, the values cannot be directly compared to the values of the calculation via PHPP. (The calculation according to Minergie(-P) standard usually achieve lower values (refer to: Zentrum für Energie und Nachhaltigkeit im Bauwesen. Minergie und Passivhaus: Zwei Gebäudestandards im Vergleich – Schlussbericht. 2002. Page 6)
The limits for this hospital building are:
New building, hospital: 38 kWh/m^2a (according to SIA 380/1:2007, converted from 136 MJ/m^2))

3 Results

Nr.		Title	Must criteria (M)	max. points	**evaluated points**
A		Quality of location and facilities		max. 100	**100**
A	1	Access to public transport network		50	**50**
A	2	Ecological quality of site		50	**50**
B		Process and planning quality		max. 200	**200**
B	1	Decision making and determination of goals		25	**25**
B	2	Formulation of verifiable objectives for energetic and ecological measures	M	20	**20**
B	3	Standardized calculation of the economic efficiency	M	40	**40**
B	4	Product-management - Use of low-emission products		60	**55**
B	5	Planning support for energetic optimization		60	**55**
B	6	Information for users		25	**25**
C		Energy & Utilities (Passive house)		max. 350	**350**
C	1	Specific heating demand (PHPP)	M	100	**85**
C	2	Specific cooling demand (PHPP)	M	100	**91**
C	3	Primary energy demand (PHPP)	M	125	**125**
C	4	CO2-emissions (PHPP)		50	**50**
D		Health and Comfort		max. 250	**225**
D	1	Thermal comfort in summer		150	**n/a (150)**
D	2	Ventilation - non energetic aspects		50	**25**
D	3	Daylight optimized (+ lighting optimized)		50	**50**
E		Building materials and construction		max. 200	**15**
E	1	$OI3_{TGH-lc}$ ecological index of the thermal building envelope (respectively OI3 of the total mass of the building)		200	**15**
Sum				max. 1000	**890**

[Pictures from Stadt Zürich – Amt für Hochbauten]

4 Conclusions from the building evaluation with the ENERBUILD-Tool

a) Generally

Retrieving the required information was quite difficult. Different sources had to be requested, reviewed and compared. If further tools are needed as part of the ENERBUILD-Tool evaluation (particularly PHPP and the OI3 calculator), the corresponding data for those tools has to be gathered, determined via auxiliary calculations, or estimated if not available.

b) About the planning process

The information about the planning process of the building, further data concerning the location, health and comfort was requested from architects/ planners of the building using a questionnaire. If available, they kindly provided the relevant information, so the values could be implemented into the ENERBUILD-Tool.

c) About the building itself

Since not all data, which the PHPP calculation would need, could be retrieved, there might be deviations. Also, the Swiss Minergie-P standard consults other floor areas (heated gross floor area) and calculates the demands differently. Thus, a comparison between the results of PHPP and Minergie-P cannot be taken to draw conclusions from. Since the PHPP only accounts to about one third of the possible points of whole ENERBUILD-Tool, those deviations were considered to be insignificant. Assigning e.g. the value of “C1 - Specific heating demand”, the target value of 15 kWh/m^2a is based on PHPP calculation, while the initial value (local limit for heating demand) is based on other national calculation methods (SIA 380/1). Therefore, determining the score for the ENERBUILD-Tool will most likely always be subject to deviations.

d) About the evaluation process

The relevant information about the building consists of gathered results (e.g. national/ local certification standards) and, thus, calculated values, which depend on their calculation method. This means they

cannot be transferred directly into the ENERBUILD-Tool. Tracing them back to their origin to finally use them for PHPP and OI3-Index calculations, which themselves are part of the ENERBUILD-Tool, is quite time-consuming.
Also, the evaluation relies on the help of planners and architects, who need to provide further information which was not relevant for the local certification process (e.g. the “Ecological quality of the site”). If data is missing, there is little room for estimates.

5 Suggestions for improvement of the ENERBUILD-Tool

There could be an option to adjust the maximum score if not all criteria could be evaluated, so that with a potential maximum “800 points” and achieved “600 points”, the overall achievement would still be 75%.

Furthermore, e.g. for “D1 - Thermal comfort in summer” the maximum score cannot be reached without dynamic calculation. Thus, maxing out the potential score, another more complex tool would have to come into consideration. This seems not to be very user friendly, comparing the cost-benefit ratio.

Another suggestion is to clarify the distribution of the score for each portion of the Enerbuilld-Tool. The descriptions how to distribute the points of the “Prescription ENERBUILD-Tool Criteria” are diverse: one uses a formula, while another one has to be interpolated, and a third one needs another complex tool etc. Also “D2 – Ventilation – non energetic aspects” two times lists the same criteria for sound imission measurements while assigning different scores.

Providing a list and overview of the required (sub) tools to convert basic data/ information into scores for the ENERBUILD-Tool would be helpful as a checklist for involved institutions or planners/ architects etc.

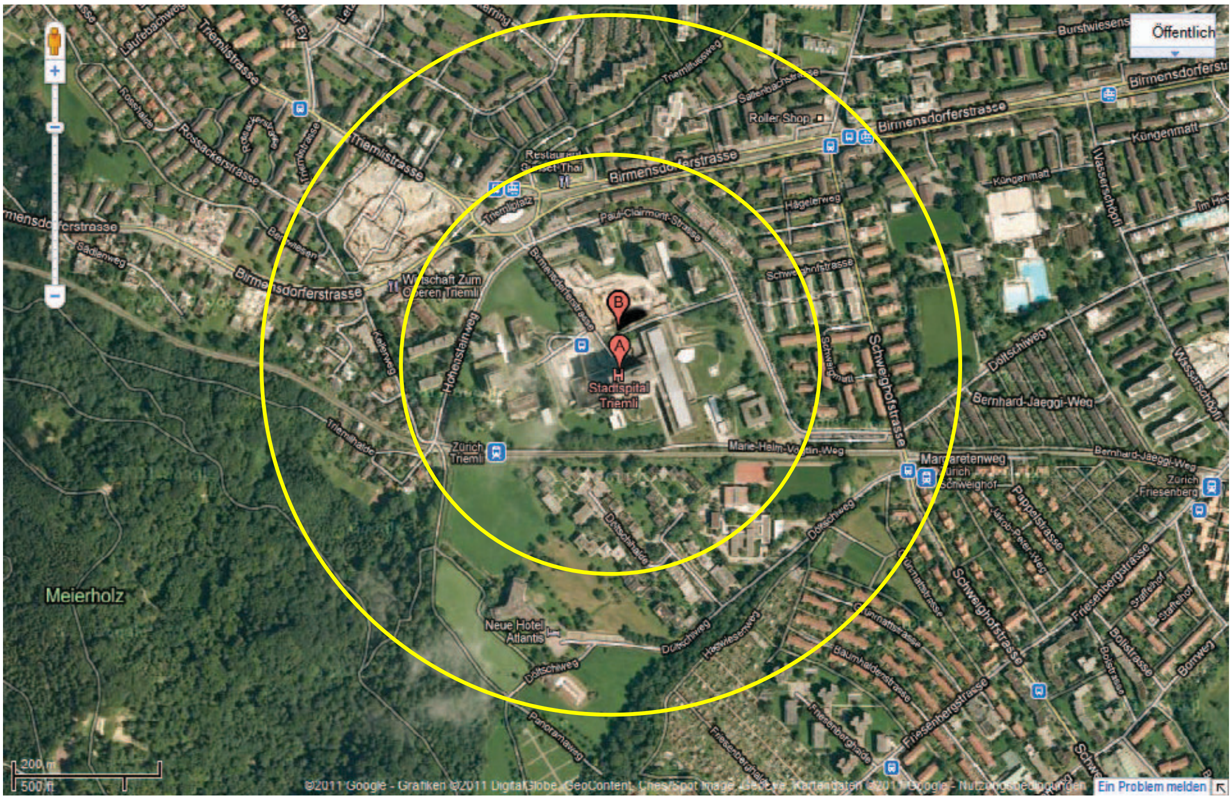
The “E1 – $OI3_{THG\text{-}lc}$ ecological index…” uses contradictory indices. All of the following indices are mentioned: $OI3_{TGH\text{-}lc}$, $OI3_{TGH\text{-}BGF}$, $OI3_{TGH\text{-}BGF\ WG\ Ref.}$ → there should be clarification. Maybe also the possibility of (just) calculating the surfaces and their specific OI3 of the construction *without* another tool would help to lighten the process. If Ecosoft is used, the OI3 index for “construction & maintenance” could also be an interesting addition to the broad approach of the ENERBUILD-Tool.

Detailed evaluation of criteria

A Quality of location and facilities

A 1 Access to public transport network

The analysis of the public transport network shows two bus/ tram stations with lines leaving in several directions within the given radius of 300 m. In addition, there are two railway stations (connected by the same line) within the required distance of 500 m with trains leaving in two directions.



[www.google.com/maps; distances shown: 300m, 500m]

Bus line 80, Zurich, Triemlispital to Zurich Oerlikon distance < 300 m, 1 departure/ half an hour 10

Tram line 9, Zurich, Triemli to Zurich, Hirzenbach, distance < 300 m, 1 departure / half an hour 10

Tram line 14, Zurich, Triemli to Zurich, Seebach, distance < 300 m, 1 departure / half an hour 10

Bus line 73, Zurich, Triemli to Zurich, Milchbuck, distance < 300 m, 1 departure / half an hour 10

Train line S10, Zurich Triemli to Zurich main station, distance < 500 m, 1 depature / half an hour 8

Train line S10, Zurich, Triemli to Uetliberg, distance < 500 m, 1 departure / half an hour 8

A1 Access to public transport network	(max. 50 points)	50

A 2 Ecological value of land used for construction

Before construction, the function of the site was buildings, infrastructure, streets (“Code a1 – area with zero ecological value”). Thus, the pre development ecological value of the site was calculated “1.0”, resulting in the maximum performance score of “5.0” using the “Land ecological value calculator”.

A 2 Ecological value of land used for construction	(max. 50 points)	50

B Process and planning quality

B 1 Decision making and determination of goals

A documentation of the decision making process is existing		(max. 10)	10
Variants were considered and evaluated		(max. 5)	5
The “0-variant” was not considered		(max. 5)	-
A documentation of the evaluation scheme of the variants is existing		(max. 4)	4
It contains:	Urban planning	(max. 2)	2
	Access to public transport	(max. 2)	2
	Use of land area and ground quality	(max. 2)	2
	Energy efficiency	(max. 2)	2
	Ecological use of materials	(max. 2)	2

B 1 Decision making and determination of goals	(max. 25 points)	**25**

B 2 Formulation of verifiable objectives for energetic and ecological measures

The following goals have been defined:

- A space allocation plan, including the determination of values concerning room size, use, temperature, and ventilation rates was defined for the whole building
- Energy and energy efficiency goals were set according to the Swiss Minergie-P (passive house) standard. Among others, they include the specific heating demand, the specific cooling demand, the specific total primary energy consumption, and the air tightness rate (in coordination with the Minergie association)
- Ecological goals were set according to the Swiss Minergie-P-eco (ecological passive house) standard. Building materials, which must not be used, were defined and the use of regional building materials was determined

B 2 Formulation of verifiable objectives for energetic and ecological measures	(max. 20 points)	**20**

B 3 Standardized calculation of the economic efficiency

The life cycle cost and the economic efficiency were calculated according to the standardized method of the ISO 15686-5.

B 3 Standardized calculation of the economic efficiency	(max. 40 points)	**40**

B 4 Product-management – Use of low-emission products

A documentation of the ecological optimization during the design process, the building permit application process, and the implementation planning was conducted	(max. 10)	10
At the call for tenders, all (100%) of the trade disciplines were indicated as “ecological”	(max. 20)	20
A major part (80%) of the building products was declared and documented	(max. 30)	15
The construction process was monitored regarding ecological matters	(max. 20)	20

B 4 Product-management – Use of low-emission products	(max. 60 points)	**55**

B 5 Planning support for energetic optimization

[Since the construction of the building will probably be on-going until 2015, some answers are stating that tests and protocols *will be* conducted upon completion of the building]

A space allocation plan, including the determination of values concerning room size, type of use, time period of use, intensity of use, and temperature was defined	(max. 5)	5
Air ventilation rates were determined separately for each room according to hygienic needs	(max. 5)	5
The internal thermal loads were determined	(max. 5)	5
Thermal bridges were considered (using a default value of 0.03 W/m^2K or a detailed analysis)	(max. 5)	5
Energy aspects and requirements were described at the call for tenders	(max. 5)	5
Offers were checked for conformity with the call for tenders (regarding energy aspects)	(max. 5)	5
The site manager was supported by on-site meetings on energy aspects	(max. 5)	5
A blower-door test will be conducted and recorded upon completion of the building	(max. 5)	5
The initial measurement of the ventilation system will be conducted and recorded upon completion of the building	(max. 5)	5
The heating system will be hydraulically adjusted and recorded	(max. 5)	5
Upon completion of the building and after the blower-door test the energy demand calculation will be updated	(max. 5)	-
Upon completion of the building, an independent evaluation of the energy demand calculation will be conducted by measuring the results	(max. 5)	5

B 5 Planning support for energetic optimization	(max. 60 points)	**55**

B 6 Information for users

The users' needs were met in 55 work groups. The users were informed and given a handbook that covers space air temperature (adjustment of heating/ cooling), mechanical ventilation and window ventilation, glare and sun blinds, general lighting and localized lighting, and energy efficient use of appliances and power consumers (e.g. computers)

B 6 Information for users	(max. 25 points)	**25**

C Energy & Utilities

Since not all data, which would be needed for an absolute concluding PHPP calculation could be retrieved, the values given must not be equated with an official Passive House (PHPP) certification!

C 1 Specific heating demand (PHPP)

Local limits for heating demand: in Switzerland the local limit for the heating demand is determined by the building's location (mean annual temperature), the building surface-to-heated floor area ratio, and its use. Also the limit differs according to the energy standard. Since the treaded floor area is calculated differently and the basic data is also taken into account differently, the values cannot be directly compared to the values of the calculation with PHPP. Still, due to lack of other limits, this value has been taken as base for the determination of the ENERBUILD-Tool points.

The limits for this hospital building are:

New building, hospital:	38 kWh/m^{2}a (according to SIA 380/1:2007, converted from 136 MJ/m^2)

For comparison the following limits are also given:

Minergie (low energy) standard, hospital:	70 kWh/m^{2}a (according to SIA 380/1:2009)
Minergie-P (passive house) standard, hospital:	45 kWh/m^{2}a (according to SIA 380/1:2009)
Specific heating demand Minergie-P:	15 kWh/m^{2}a (according to SIA 380/1:2007, converted from 54 MJ/m^2)

Specific heating demand PHPP: **19 kWh/m^{2}a$_{EBF}$** (calculated with PHPP)

C 1 Specific heating demand (PHPP)	(max. 100 points)	**85**

C 2 Specific cooling demand (PHPP)

Specific cooling demand: **1 kWh/m^{2}a$_{EBF}$**

C 2 Specific cooling demand (PHPP)	(max. 100 points)	**91**

C 3 Primary energy demand (PHPP)

Primary energy demand: **76 kWh/m^{2}a$_{EBF}$**

C 3 Primary energy demand (PHPP)	(max. 125 points)	**125**

C 4 CO2-emissions (PHPP)

CO2-emissions: **19 kg/m^2a_{EBF}**

C 4 CO2-emissions (PHPP)	(max. 50 points)	**50**

D Health & Comfort

D 1 Thermal comfort in summer

Relation of opaque surfaces (48%) to transparent surfaces (52%) of the façade.
A dynamic simulation was not conducted.
Several indicators make it plausible, that the thermal comfort in summer will most likely be guaranteed: The overheating frequency result applied to 26°C from PHPP is stated 0%. A pilot and demonstrational mock-up up (scale 1:1, incl. façade, patient rooms, and service areas) was used for testing. The building will have structural sun protection, adjustable sun blinds, clay plastered ceilings for thermal mass and active cooling via thermal ground probes. Thus, the thermal comfort in summer is expected to achieve the maximum score within the ENERBUILD-Tool calculation.

D 1 Thermal comfort in summer	(max. 150 points)	**n/a (150)**

D 2 Ventilation – non energetic aspects

A pilot and demonstrational mock-up (scale 1:1, incl. façade, patient rooms, and service areas) was built. A prognosis on sound immission was established, and the mock-up was also measured and documented concerning sound aspects.

The data regarding the measurement was n/a.

D 2 Ventilation – non energetic aspects	(max. 50 points)	**25**

D 3 Daylight optimized (+ lighting optimized)

The daylight factor is ≥ 5%

D 3 Daylight optimized (+ lighting optimized)	(max. 50 points)	**50**

E Building materials and construction

E 1 $OI3_{TGH-lc}$ ecological index of the thermal building envelope (respectively OI3 of the total mass of the building)

Using Ecosoft, the OI3-index was calculated. No further adjustments according to the life span of materials have been done. Since the hospital is a high-rise building, certain requirements for building materials occur.

$OI3_{TGH-BGF_h}$ = 264 [$OI3_{TGH-lc}$ = 74]

points = 2 * (0.0007 * $OI3_{TGH-BGF_h}{}^2$ – 0.623 * $OI3_{TGH-BGF_h}$ + 123)

points = 2 * (0.0007 * 268^2 – 0.623 * 265 + 123) = **15**

E 1 OI3 ecological index of the thermal building envelope	(max. 200 points)	**15**