CERTIFICATION OF SUSTAINABILITY – CASE STUDY ANALYSIS OF NEW GERMAN STANDARD

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Abstract

The federal government is the largest public client and owner in Germany and therefore has an exemplary role according to sustainable building. New sustainability requirements for federal buildings were defined by the Federal Building Ministry in the last years. For example, the higher quality standard "Silver acc. to the Assessment System for Sustainable Building (BNB)" was mandatory established for all new office buildings, new educational buildings and new laboratory buildings.

Since 2015 the first results of complete certification processes are available. As one of the first federal buildings the new Federal Ministry of Education and Research in Berlin was certified with the BNB Gold Certificate. Because of the attested degree of fulfilment of 86.2% for this outstanding pilot project, it is now the best federal building according to proven sustainability requirements.

Special and innovative features of the building include for example a reduced energy demand (optimized heat insulation, PV modules integrated in the façade, gas-powered fuel cell), optimized selection of materials, optimized flexibility and optimized accessibility. Beside these building aspects there were also implemented exemplary quality assurance systems during the whole planning and construction phase. These experiences can be utilized for new recommendations for sustainability projects in the public sector.

Keywords: assessment system for sustainable building (BNB); results of certification; best practice; new sustainability requirements of German government; federal project with highest sustainability standard

1 INTRODUCTION

Building in Germany is being geared towards sustainability. The German criteria checklist for the comprehensive assessment of sustainability aspects of buildings was developed by Federal Building Ministry and the German Sustainabilty Council DGNB and is now used by the public sector and in a similar way by the private development sector.

The Assessment System for Sustainable Building (BNB) focuses on the entire life cycle of the built environment, covering all aspects from planning and construction to building operation with a view to optimizing overall quality.

As part of the German government, its sustainability strategy is assuming an exemplary role in implementing sustainability objectives in construction.

Specific requirements for federal building projects are set out in the Sustainable Building Guidelines and the associated Assessment System BNB. The overall requirement is to attain the “Silver Standard” according to BNB for those federal buildings for which a BNB variant is available.

So in the last years the BNB was established as one of the most important instruments for the implementation of higher quality requirements for federal buildings.

Since January 2015 the first results of complete certification processes are available. As one of the first federal buildings the new Ministry of Education and Research in Berlin and the new Federal Environment Agency in Berlin were certified with the BNB Gold Certificate.

2 IMPLEMENTING SUSTAINABLE REQUIREMENTS FOR FEDERAL BUILDINGS

2.1 Principles of Sustainable Building

In general, the classical understanding of sustainability is based on three dimensions as shown in figure 1: ecology, economy and socioculture, which are to be considered over a long period of time. The goal is to observe and to evaluate the entire useful life of a building – colloquial referred to as the life time of a building. For the actual observations of the life cycle, the first 50 years of a building are worked into the calculations.

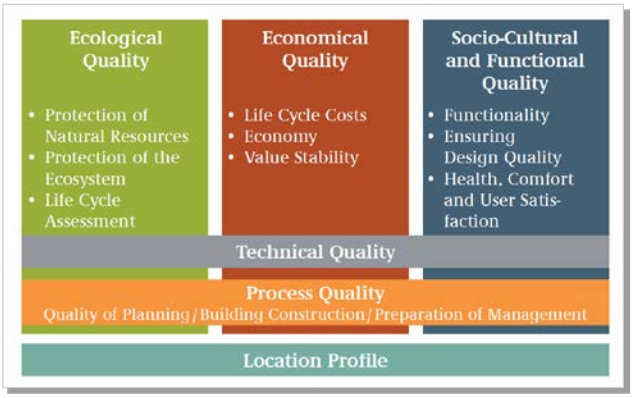

Figure 1. Qualities of Sustainable Building

The main goal sought in the ecological dimensions is primarily the protection of resources by optimally using construction materials and products, minimising use of space and of media (e.g. heat, electricity and water).

All requisite energy and material flows from the gain through the refinement and transport to the installation or disassembly alongside the global and local effects on the environment made by the energy use of the construction materials or the buildings will be considered. Generally, this reduces environmental pollution at a local and global level. The most different methods of analysis, e.g. risk analysis, analysis of the material flow, the material analysis and the ecological balance, are to be applied to objectively assess the environmental compatibility of construction products and the variations in building this brings.

The costs which go above and beyond the mere costs of purchase and assembly – especially the life cycle costs are considered in the economical dimensions of sustainability. This places the focus on life cycle costs relevant to the building, the economic viability and the value stability. As practice has shown, the life cycle costs can by far exceed the costs of construction. By analysing the life cycle costs, considerable opportunities for saving money during planning can be identified. As Life-Cycle-Costs (LCC), the costs of construction, the construction use costs and the demolition costs are additionally considered.

In addition to the question of functionality, the question of aesthetic design, the health aspects and comfort are relevant points in considering the social and cultural dimensions of sustainability. Winter and summer heat insulation contribute to comfort just as much as the noise protection or a deliberately chosen type of construction material (e.g. the use of emission free products). Construction designs, choice of material, building construction and technology are to be interpreted to that effect and to be optimised, if needed. At the same time the construction design is to be made flexible enough that it can be easily adapted to the changing parameters e.g. change of use/user. Alongside the ecological, economical and sociocultural aspects, the functional and technical properties (technical quality), the planning and implementation (process quality) and the, in part, local characteristics are decisive for the description and value of a building. This has extended the three columns of sustainability to five quantifiable qualities of sustainability – informatively supplemented by the local characteristics (cf. Figure 1). The various aspects of sustainability interact directly with each other, so that the goal becomes a holistic and simultaneous assessment of every aspect.

2.2 How to use the "BNB"

The planning-based Assessment System for Sustainable Building (BNB) is distinguished for its comprehensive consideration of the entire life cycle of buildings. The assessment of building qualities is accomplished in accordance with transparent rules and objective, essentially quantitative methods.

No individual measures are evaluated in the results-oriented system, but rather their documentable effect on the overall concept of the building. Its application takes place throughout the planning stages, which means that it contributes not only to the optimization of the building but also and at the same time to quality assurance.

The BNB is organized into three different levels. The actual definition of the qualities takes place on the criteria level. These are described in detail in 46 criteria profiles on the basis of a total of around 150 indicators. The criteria profiles are grouped thematically in 11 criteria groups and 6 main criteria groups, thus making it possible to identify special qualities on each level.

Nachhaltiges Bauen

Figure 2. Logo of BNB in Gold © BMUB

On the basis of the degree of fulfilment, a score is assigned to the quality levels – Gold, Silver or Bronze. The results are presented in greater detail on a certificate with the Logo of BNB as shown in figure 2 and 3, representing the respective quality level. Additional information regarding the building is contained therein.

The modular structure of the system enables a differentiated presentation of the results; particular attention can thus be drawn to exceptional qualities in one or more subordinate areas of the assessed building.

The BNB and additional planning tools are published via the Sustainable Building Information Portal of the Federal Building Ministry (www.nachhaltigesbauen.de). Some selected contents are available in English.

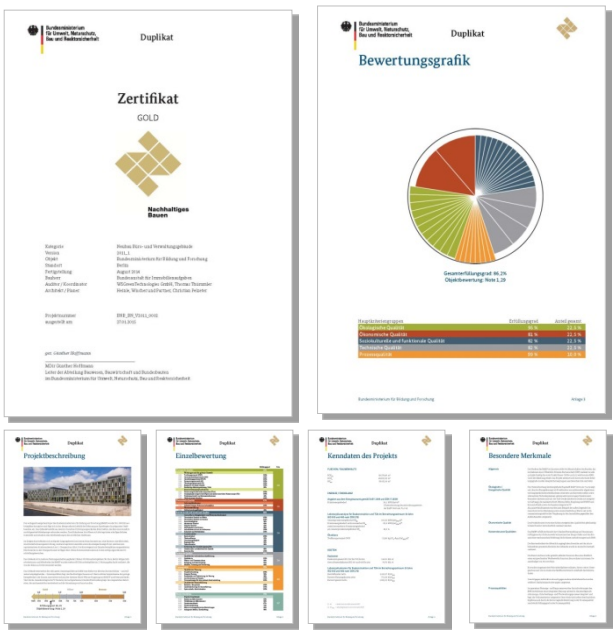

Figure 3. BNB Gold Certificate for BMBF

3 CERTIFICATION OF THE FEDERAL MINISTRY OF EDUCATION AND RESEARCH IN BERLIN

3.1 General Information on the Project

The new Federal Ministry of Education and Research in Berlin is the first federal civil building project that was realised by Public Private Partnership (PPP) and likewise the first building of that kind and size that received a certificate of BNB in gold. The project distinguishes itself by very high qualities and degrees of fulfilment in all main criteria groups of the assessment system BNB (81% - 99%).

This outstanding pilot project is now the best federal building according to proven sustainability requirements.

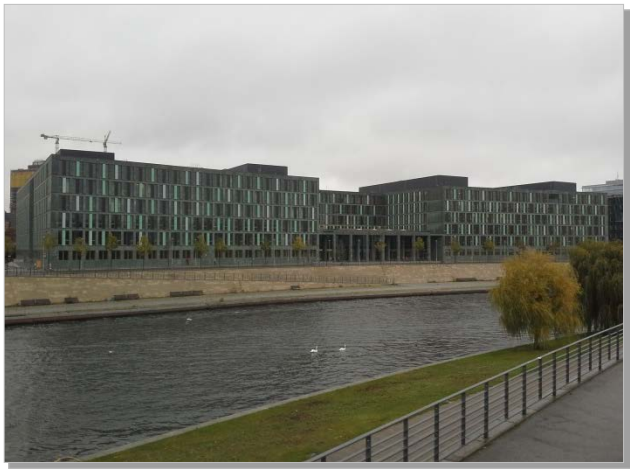

Figure 4. Federal Ministry of Education and Research in Berlin (BMBF)

The six-storey building of the Federal Ministry of Education and Research (BMBF) was designed for 1,000 office workplaces and is integrated in the existing development at the Berlin "Spreebogen" vis-a-vis the government district as a recognizable city block (figure 4).

Table 1. Characteristics of BMBF

Users	Federal Ministry of Education and Research and others
Owner	Institute for Federal Real Estate (BImA)
Building Category	Administration Building
Type of Project	Public Private Partnership
Total Building Costs	115 million Euro
Architect	Christian Pelzeter, Heinle, Wischer und Partner, Berlin
Building Company and Contractor	BAM Deutschland AG
Completion	August 2014
Gross Floor Area	58.000 m²
Workplaces	1.000
BNB Certificate	Gold (86.2%)

The building with specific characteristics shown in table 1 is composed by two office wings which are arranged U-shaped and are connected by a centrally placed part of the building. The greened and noise-protected interior courtyards (figure 5) are opened to the railway line and thus enable a visual connection to the northern urban space.

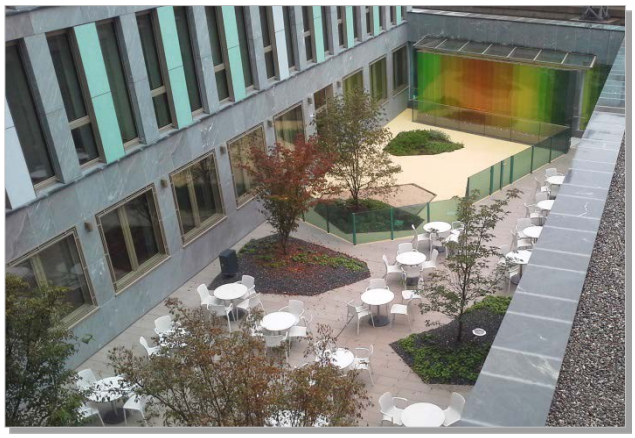

Figure 5. Interior Courtyard

On the ground floor there are located the entrance area with a visitors center, a canteen, a library, childcare facilities, five greened interior courtyards and the two-storeyed foyer that leads to the conference center at the first floor. The offices on the upper floors are mainly designed as single-user workplaces and are supplemented with spacious open communication areas in the centered corridors (figure 6).

Figure 6. Communication Area

The building is structured in several utilization units. Beside the 350 office workplaces for the employees working in Berlin, other 650 office workplaces which are rented for third parties were realized in a second utilization unit.

The building features an excellent overall quality that is recognizable by the gold certificate with a degree of fulfilment of 86.2 % and it features a number of over-average – and in parts outstanding – specific qualities according to sustainable building as shown subsequently.

3.2 Specific Qualities according to Sustainability

Ecological and Energetical Quality

The energy concept for BMBF combines measures of optimizing the building physics according to the construction and technical systems which are in some places conventional and in other places very innovative.
As a result the energy demand of only 36.1 kWh / (m²a) deceeds the strict requirements in Germany for this project by 71.6 %.

Special and innovative features of the building for reducing the energy demand are for example:

- optimized heat insulation (heat transfer coefficient walls: 0.19 W/(m²K); heat transfer coefficient windows 0.84 W/(m² K))
- photovoltaic modules on the flat roof and integrated in the façade that produce about 100,000 kWh electric energy per year (figure 7)

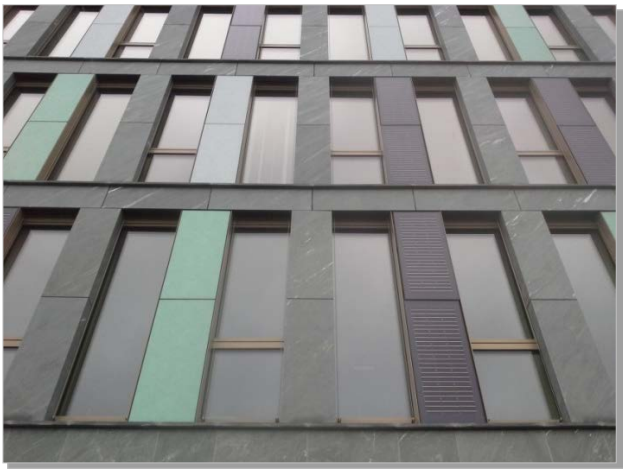

Figure 7. PV Modules in the Façade

- thermal activated ceilings instead of radiators in the offices
- ventilation system with heat recovery in every office, in conference rooms sensitive to CO_2 concentration
- LED lighting sensitive to movement and daylight in all offices (figure 8)
- external jalousie with light-diffusing slads in upper third and internal sun-blind with translucency in upper third for maximizing daylight even in a closed state (figure 9)

Figure 8. LED Lighting; Sun Shutter with Translucency in upper Third

- combined heat and power (CHP) with block-type thermal power station (BTTP) and gas-powered fuel cell (table 2) for generating electricity, heat and cooling instead of district heat (this system minimizes the primary energy demand and the CO_2 emission)

Figure 9. Jalousie with light-diffusing Slads

- the different system components are cross-linked with the building management system (BMS) by an intelligent interconnection (smart grid)

Table 2. Characteristics of Fuel Cell System in BMBF

Type	Molten Carbonate Fuel Cell, MCFC
Producer	Fuel Cell Energy Solutions GmbH
Electrolyte	carbonated
Operating Temperature	600–650 °C
Fuel Gas	natural gas
Output Power	250 kW electric, 160 kW thermic
Efficiency	47 % electric, 79 % total (acc. to lower heating value)
Savings Compared to Seperated Generation	about 30 %

Economical Quality

The project could be realized in a high economic efficiency because of and despite a high energetic quality and a high level of comfort for the user. In order to ensure the flexibility and adaptability of the building for

possible changing user demands in the future, the building enables different types of efficient office structures (figure 10).

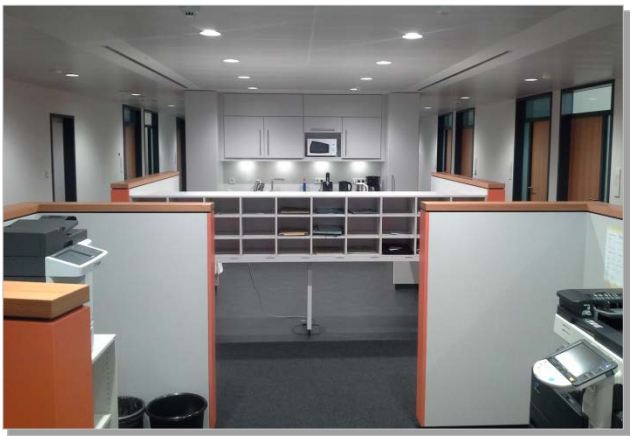

Figure 10. Office Facilities, Mailboxes and Tea Kitchen in open Areas

Socio-cultural and Functional Quality

The requirements according to the user demand for a high level of comfort are met by numerous aspects, as for example:

- According to indoor air quality and avoidance of harmful substances the highest quality levels of BNB were met by choosing low-emission building products and by ventilation system in every office.
- The accessibility of the foyer and of the office areas was raised to the highest degree (building, interior courtyards and floors are accessible without steps; well-spaced corridors and office rooms for wheelchair users; tactile guidance strips (figure 11); speech modules in elevators; information in Braille or raised letters; barrier-free toilets on every floor)

Figure 11. Tactile Guidance Strips

- A competition for art in architecture was realized with more than 300 submitted designs of which 4 were chosen: a sandblasted lettering „why do I not know simply everything" at indoor glazing (artist: E. Prautzsch); a virtual sculpture of air, light and water vapour with a connotation to a rainbow at the banister in the foyer (figure 12); a mirror glas with 2000 LED lights at the interior wall of the conference center illustrating fictitious constellations (figure 13); a slate of 30m² with a machine that writes computer-operated sketches, graphs and patent drawings with chalk (figure 14).
- 282 bicycle stands are available for the employees.
- A high level of noise protection was realized.

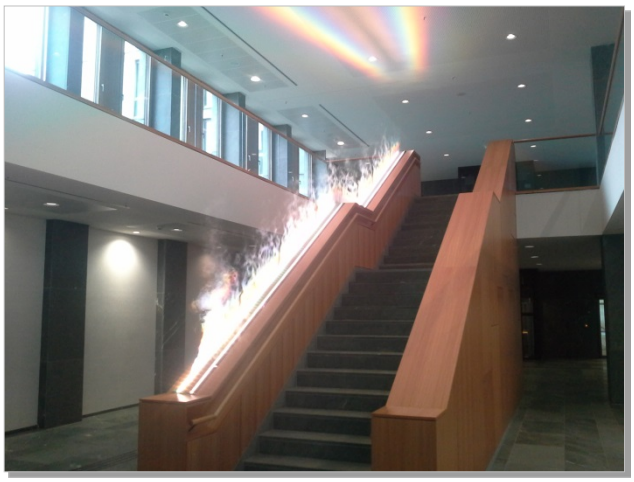

Figure 12. Virtual Sculpture (artists B. Burchhardt, A. Lippke, M. Stammen)

Figure 13. Mirror Glas with 2000 LED (artists A. Anklam, T. Henninger)

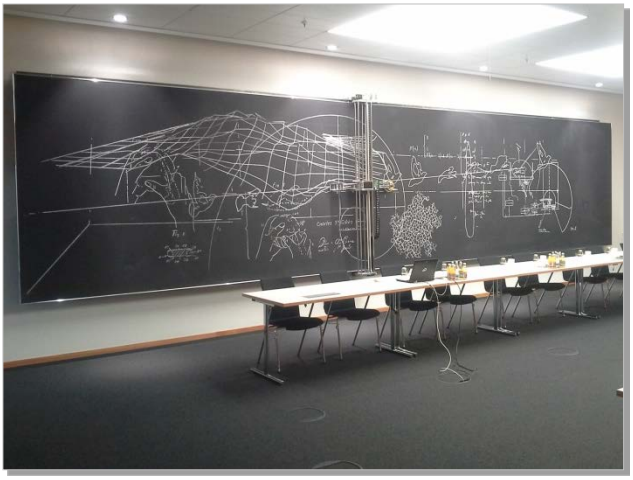

Figure 14. Slate with Writing Machine (artists A. Anklam, T. Henninger)

After the first months in use the Federal Minister of Education and Research Johanna Wanka said "We feel very comfortable in these sustainable premises."

Process Quality

The requirements of sustainable building were considered by an integral planning and a holistic approach during the whole planning and building process. The procurement and the supply of materials were controlled with an extraordinary effort and the extent and quality of the building and material documentation is exemplary. The degree of fulfilment of the requirements of BNB according to process quality is 99%.

4 OTHER EXAMPLES AND OUTLOOK

Beside the BMBF numerous other current federal building projects consider the requirements of the BNB, like for example:

The new office building for 32 employees of the Federal Environment Agency in Berlin (figure 15) is designed as the first federal "zero energy building" and received the certificate of BNB in gold in 2015 (more information: www.umweltbundesamt.de/).

Figure 15. Federal Environment Agency

The renovation and reconstruction of the listed Federal Constitutional Court in Karlsruhe (figure 16) received the first certificate in silver according to BNB for complete refurbishment (more information: www.bnb-nachhaltigesbauen.de/).

Figure 16. Federal Constitutional Court

The aim for the new extension building for 100 employees of the Federal Environment Agency in Dessau (figure 17) is a "zero energy building" and a certificate of BNB in gold (more information: www.umweltbundesamt.de/).

Figure 17. Federal Environment Agency

The aim for the new exhibition and event building of the Federal Ministry of Education and Research in Berlin called "House of the Future" (figure 18) is a quality of sustainability analogue to "BNB Gold" (more information: www.hausderzukunft-deutschland.de/).

Figure 18. "House of the Future"

All these projects are a part of the sustainable strategy of the federal government and the experiences can be used for new recommendations or future requirements for sustainability projects in the public sector.

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