INTEGRATED APPROACH FOR SUSTAINABLE REFURBISHMENT OF PUBLIC BUILDINGS IN AUSTRIA: THE BIGMODERN-PROJECT

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Summary

Bundesimmobiliengesellschaft m. b. H. (BIG holding) is one of Austria's most important property owners and owns real estate assets comprising roughly 2.800 public buildings (schools, universities, administration buildings). Its core business is management and administration of properties, ranging from new construction to demolishing. The refurbishment projects suffer from strict investment budget limits. Additional costs for high energy and sustainability performance are difficult to accomplish under given budget regimes and current planning processes. Given the fact that EPBD requires public building owners to take a front-runner position in energy efficient refurbishment of building stock BIG has started to BIGMODERN project which follows a comprehensive and structured way in introducing high levels of energy performance and sustainability into its refurbishment project. The BIGMODERN project started in the 2009. In the meantime the construction process of the first demonstration projects has been completed. The paper gives an overview on the results achieved and on the lessons learned so far.

Keywords: integrated design, major renovation, public buildings, energy performance

1 Public building administration in Austria

The BIG holding of Austria's largest public real estate companies owning roughly 2,800 public buildings which comprise a total building area of approx. 7 million m^2. The portfolio consists of the following segments: schools (about 40 %); universities (about 12 %) and special property (about 12 %). Approx. 1,200 of these properties were built in the period between the 1950s and the 1980s. Since January 2013 the BIG holding has furthermore concentrated its portfolio in the administration and office segment as well as development property into an affiliated company called ARE Austrian Real Estate GmbH.

BIG is the landlord and owner of the properties. General refurbishments of BIG are commissioned by the tenants of the very buildings. The standard process of BIG is presented in Figure 1.

The steps in the process are as follows: First of all, the budget for construction is approved by the Finance Ministry and distributed to the federal ministries. Within these

ministries, the projects and the requirements are evaluated in cooperation with the users of the building.

Having selected the projects, the design phase starts. Only after the lease contract is signed at the draft stage of the design, the BIG is entrusted with the implementation of the project. Therefore on the one hand, BIG has the public contract to implement a sustainable, highly energy-efficient refurbishment, but on the other hand BIG also has to take economic aspects into account. Any additional costs for investments that reduce energy demand in operation would have to be borne by the tenants. The tenants, however – most often ministries, universities, etc. – are also struggling with limited budget resources, as means for investments in buildings are seldom envisaged in the budget. This entails that the BIG gets caught in the classic investor-user dilemma during renovations, which usually leads to conventional and not sustainable or innovative remediation.

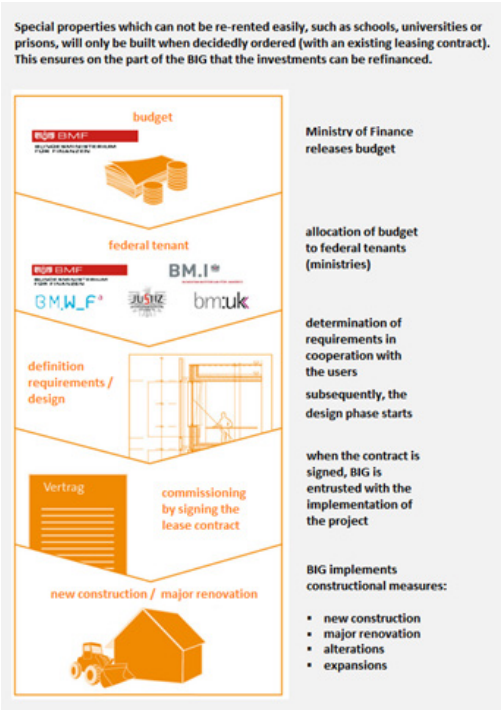

Fig. 1 *Standard procedure as applied by BIG for complete refurbishments (source: BIG)*

2 The BIGMODERN project: Objectives, Approach, Results

Given the fact that EPBD requires public building owners to take a front-runner position in energy efficient refurbishment of building stock BIG has started to BIGMODERN project which follows a comprehensive and structured way in introducing high levels of energy performance and sustainability into its refurbishment project. The BIGMODERN consists of the following core elements:

- Establishment of two large demonstration projects aiming at high energy and sustainability performance. Hence the long time profitability (by calculating life cycle costs) and functionality of the measures will be taken into account.
- Introducing sustainability and energy efficiency-criteria as essential guiding principles for planning and construction processes, based on know-how and experience from the demonstration projects.
- Comprehensive implementation of energy monitoring, by the help of which the success of the taken refurbishment measures can be analyzed and evaluated.

2.1 Integrated design process as corner-stone of BIGMODERN

The integrated design process has been an issue in the construction industry for several decades. A key motivation for this is the increase in requirements for buildings that need to be covered during the planning phase already. Many aspects of the building are concerned by energy issues. In addition to the key components such as façade and building services,

the effects on the user, on the indoor environment or on the energy balance of the materials used are energy-related aspects during construction.

The goal of integrated design is to find an optimum solution for the numerous single targets of the project. This shall be achieved at a lower cost than by achieving the single targets independently one after the other.

Therefore integrated design can be used in the new construction as well as in the renovation of buildings. By looking at the different aspects of such an undertaking holistically, different goals can be set into relation and synergies can be utilized (Hofer et al., 2006).

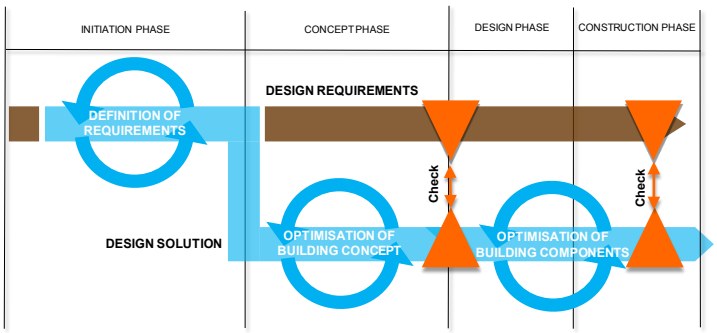

Fig. 2 *Design phase and activities (Source: M.O.O.CON GmbH, Hofer G. 2011)*

In the BIGMODERN project the integrated planning process starts even before the first plan of the building exists (compare Figure 2). In the initiation phase target criteria are defined which derive from the strategic goals and wishes of the client. These target criteria are based on comprehensive sustainability criteria. However, they can also be prioritized upon certain issues and topics. The criteria are part of the tender of the designer. Hence, orientation can be given for the first draft, as to how the building is to be designed. When the primary preliminary of the plan is finished, initial testing and optimization steps are performed. Here the plan is tested to see whether the sustainability criteria are met. At the same time, and in contribution of the overall integrated design team, the building is optimized as best as possible. In this specific case, the focus has been set on energy optimization and its impact on life cycle costs. This applies to both the preliminary and the design. In the preliminary the focus lies on systemic decisions and in design component solutions are to be optimized.

2.2 Results of the first demonstration projects

Within the scope of the BIGMODERN-project, two demonstration projects have been realized, namely the office building in Bruck/Mur and the construction engineer faculty building of Innsbruck University. The refurbishment is already completed as far as the office building in Bruck/Mur is concerned. Regarding Innsbruck University, the invitation to tender for this construction project is currently carried through. Therefore, the results of the administration building in Bruck/Mur are presented in the following.

Based on the results of the integrated planning process, a call for tenders was carried out for the important key measures which are described below:

- Façade: In the renovation-process of the building prefabricated metal cladding panels with solar “honeycombs” for passive solar exploitation are used.
- Windows: The window elements are flush-mount integrated within the façade. The vent windows are opaque and – speaking of windows – have an excellent overall heat transfer coefficient of 0.30 W/m^{2}K. Each room contains at least one openable wing,

the rest of the window elements is tightly vitrified. A special three-pane insulating glass is used, which has an integrated daylight-directing sunscreen. The control of the blinds is radiation-dependent.

- Lighting: The offices are illuminated by presence and daylight dependent controlled floor lamps. The hallway area is lighted by a dimmable linear lighting system (presence control).
- Ventilation: In the part District Court part of the building, floor by floor ventilation systems are installed with highly efficient heat recovery systems. The ventilation of the courtrooms is done separately, utilizing a CO_2-sensor. The fresh air is provided as needed via the automatic flow controller and the speed-controlled ventilation device.
- Heating: in the course of the refurbishment, the existing gas heating is converted to biomass district heating.
- Cooling: A bivalent chiller with a deep drilling system will be integrated into the ventilation system (see description of ventilation system). In summer, the cooling water from the deep drill is used to precondition the fresh air (free cooling), in winter, the air is pre-heated by the heat pump (in addition to high-efficiency heat recovery).
- Measurement technology, instrumentation technology and control technology: The control and regulation functions for all major technical building service elements are operated by a central computer system. This allows ensuring a constant supervision of energy flows in the building and monitoring of all relevant plant components such as ventilation systems, heating and cooling groups.

By carrying out the renovation of the administration building Bruck/Mur, a substantial contribution to the reduction of both the energy input and the CO_2 – emissions is made. The heating demand of the building was reduced from 153 kWh/m²a to 24 kWh/m²a, which accounts for a reduction von 85 %. Due to the consequent reduction of net energy and the renewal of building services, the primary energy demand could be reduced. In order to increase the user comfort and to reduce heat loss, a ventilation system with heat recovery was installed in the building component district court. Hence, there will be some energy consumption for ventilation and cooling after the renovation. Nevertheless, the primary energy demand could be reduced by about 60 %. Due to the reduction of the energy demand and the conversion of the heating system to a biomass district heating system, CO_2 – emissions were reduced by about 75 %. The demo project at the office building Bruck proved that a significant improvement in energy efficiency can be achieved. Furthermore, CO_2-emissions were reduced by approximately 75 % and the ambitious targets could be achieved.

References

[1] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.

[2] Hofer, G.; Herzog, B. and Grim, M. (2011): Calculating life cycle cost in the early design phase to encourage energy efficient and sustainable buildings. eceee Summer Study 2011.

[3] Von Both, P. and Zentner, F. (2004): „Lebenszyklusbezogene Einbindung der Zielplanung und des Zielcontrolling in den Integralen Planungsprozess – LuZie“, Forschungs-Informations-Austausch, Bietigheim-Bissingen.