COMPUTER-BASED TOOL «PETRA » FOR DECISION-MAKING IN NETWORKS ABOUT THE RENOVATION OF A MIXED BUILDING ESTATE.

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Abstract

The PETRA project aims at developing an computer-based tool for decisions-making in networks for building estate management that encompasses both a rapid assessment and the planning of renovations according to different indicators.

It is addressed to all people or institutions managing a mixed building estate and particularly, to technical services for project management, architects and engineers, owner's associations and expert offices. In order to establish a correct maintenance management programme, these « clients » are in need of a method for analyzing buildings that allows to rapidly and simply «scan » the building estate and estimate the typology and the investment costs of rehabilitation interventions.

The aim of the project is to bring innovation by offering extra speed and universality for better answering the real estate market's new requirements in the area of maintenance and renovation. Indeed, the market needs fast and precise methods that help the expert to reconcile the needs of heritage protection and new energy requirements. Within the next 10 to 30 years, the biggest building estate conversion ever will take place in Switzerland. This implies the refurbishment of buildings from the years 1950-1970 that are now at the end of their lifetime and that have a 2-3 energy consumption reduction factor. Given this reality, an owner cannot only trust the manager's intuition ; this intuition must be reinforced by appropriate analytical tools such as the new method that will be developed with this project. PETRA develops a new evaluation methodology that allows to analyze the buildings' conservation state and to calculate the renovation costs of each building in a simple and quick way. In order to carry this out, a process of data aggregation and element grouping, based on existing methods previously developed by the work group (EPIQR+, INVESTIMMO), will be set up.

1. Scope

From the analysis of different building estates, it was possible to observe that the average maintenance, renovation and management costs, calculated on the lifetime of a building, are 2 to 3 times higher than the object's initial building costs. In the past, these costs have often been neglected because the focus was on new buildings. This lack of appropriate maintenance programmes has resulted in a gradual degradation of buildings. Today, we have building estates that requires urgent and significant maintenance and renovation interventions on essential elements of the construction. These interventions constitute today an increasing part in the building market. In Europe, building renovation represents approximately 40% of the civil engineering works related to buildings. In Switzerland, at least half of the investments in construction are dedicated to renovations. To insure that these interventions be effective and sustainable over time, it is indispensible that all actors involved operate according to a systematic intervention agenda, based on predictive property management that considers a series of criteria linked to sustainable development.

The PETRA project, is the answer to the lack of rapid assessment online decision making support tools for analyzing a complete building renovation. The tool is accessible through an online platform which also provides users with information such as documents and data on building maintenance and renovation. This platform is the interface of the new competence centre ("Centro di competenza sul risanamento e la manutenzione degli edifici") based on the partnership between the Institute for Applied Sustainability to the Built Environment (ISAAC) in Ticino and the laboratory for construction and Conservation (LCC) and the laboratory for economics and environmental management (REME) at the EPFL in Lausanne.

Figure. 1: Degraded building envelope elements.

2. Methods

Currently, in the area of building renovation, a comprehensive database containing all the essential information concerning the key dimensional coefficients compared to the intervention costs for all building types does not exists. The other computerized methods currently on the national and international market do not rely on such a database and particularly do not have an inductive approach that allows the analysis of a building estate starting from the analysis of each building. The PETRA project is based on the previously developed inductive analysis methods, namely EPIQR+ and INVESTIMMO. The new methodology is principally based on the following aspects :

- Modelling of all building categories
- Conceptual study of the new method based on data aggregation

The new database exploits both information already present for certain building categories and data for new categories that will be progressively implemented as the project and the utilization of the new method progress. The aggregation of new data from the existing database is a key step for allowing a quick and reliable building assessment.

The existing Access format database of the tool has been transferred to a MySQL format. This allows a web compatibility and increased flexibility. At the same time, a new data structure has been created for simplifying the analysis. Also, the present structure allows to add new data about building categories that are not yet analyzed and to refer to a lower amount of data input compared to EPIQR+ and INVESTIMMO.

	WorkID	Description	Unit	Cost	BCCid	BECid	D
☑	000-00-07	Remplacement des installations des travaux manuels	m²	370	–	–	E
☐	112-T2-08	Démolition (base 10 m2)	Forfait	3000	112	T2	R
☐	113-T2-01	Démontage de l'abris et tri pour recyclage	m²	92	113	T2	R
☐	201-F1-01	Dégrapage de l'enrobé et chargement dans une benne	m²	32	201	F1	R
☐	211-C0-01	Mise à disposition d'un point d'eau, un tableau électrique provisoi	U	3000	211	C0	I
☐	211-C0-02	Mise à disposition d'une grue stationnaire de 20 m. (Forfait: 4 moi	Forfait	13860	211	C0	I
☐	211-C1-01	Fourniture et pose d'un échafaudage (<3 mois) y compris nettoyage e	m²	11	211	C1	L
☐	211-C1-02	Fourniture et pose d'un pont de couvreur	ml	92	211	C1	L
☐	211-C1-03	Fourniture et pose d'un pont roulant	Forfait	2500	211	C1	L
☐	211-C1-04	Fourniture et pose d'un échafaudage (>3 mois) y compris nettoyage e	m²	15	211	C1	L
☐	211-C1-05	Plus value pour la fourniture et pose d'un pont roulant en fonction	ml	20	211	C1	M
☐	211-D2-01	Réalisation d'une fondation en BA pour recevoir la structure métall	U	2772	211	D2	E
☐	211-D2-02	Réalisation d'une fondation y compris excavation pour ascenseur	U	7392	211	D2	E
☐	211-E0-01	Démolition de l'ancien escalier y compris balustrade	U	878	211	E0	R
☐	211-E0-02	Démolition des balustrades en maçonnerie et évacuation à la décharg	U	462	211	E0	A
☐	211-E0-05	Nettoyage haute pression de l'escalier	m²	9	211	E0	H
☐	211-E0-06	Nettoyage haute pression de la surface et ragréage du sol du balcon	m²	92	211	E0	R
☐	211-E0-07	Piquage et réfection des scellements des garde-corps	ml	51	211	E0	A
☐	211-E0-08	Piquage et rhabillage du parapet	ml	152	211	E0	I
☐	211-E0-09	Préparation de la dalle du balcon pour réception du cadre vitré	ml	92	211	E0	A
☐	211-E0-10	Préparation des balustrades de balcon pour réception du cadre vitré	U	2772	211	E0	I
☐	211-E0-11	Réalisation d'un escalier en béton armé	U	2680	211	E0	E
☐	211-E0-12	Démolition et évacuation de l'ancien escalier y compris parapet (fo	m²	277	211	E0	R
☐	211-E0-13	Rhabillage des scellements des garde-corps	ml	37	211	E0	Ö

Figure. 2: Reorganized MySQL format database extract

3.   Results

One of the main results of the PETRA project will be the development of an network platform from which all users, through special access, will have the possibility of working on their projects using the fast assessment method established through the new database. Meanwhile, we will be able to improve the database's accuracy and reliability and to assure a systematic updating by using the information related to the users' own renovation projects.

The systematic diagnosis has been reinforced and the database extended by the online operating possibility. The frequent users that this attracts and the controlled access management, help increase its representativeness of all building types. Furthermore, by drawing on user feedback information, the database is systematically and continually supplied, controlled and updated. For the new tool to be standardized, the data goes through a reliability control.

Also, interested users can find information, documents and data on building maintenance and renovation on the platform that is also directly linked to organizations/institutions, such as the Swiss association for facility management and maintenance (www.fmpro-swiss.ch), that handle related subjects. Thus, the platform has the role of service provider and competence centre for the field.

The tool and platform will change the way actors in building management and renovation planning work and will become a benchmark for the encouragement and the carrying out of works that lessen energy consumption of buildings.

Figure. 3: Platform design

Another main result of this research project is the Renovation and issues linked to architectural conservation. The development of an extensive and meaningful database will especially apply to buildings with particular elements but not to the extent of being classified or protected. This building typology represents an important percentage of all buildings of our cities and has an enormous energetic improvement potential. Often however, it is difficult to effectively intervene because of their characteristics and particularities.

Since it is essential to know and represent the buildings characteristics in order to diagnose them in all their elements and define the intervention scenarios for their maintenance or renovation, with the PETRA approach, it is possible, even at the early project phase, to consider all aspects and restrictions that the specific building category entails.

With raw material price raise and the increased requirements of energy consumption related new legislations, energy waste reduction has become one of the key drivers of renovation. Most of the existing methods allow renovation impact assessment on energy consumption and investment costs, but this is not a satisfactory enough incentive. Indeed, a multitude of scenarios can occur while not knowing the level of regulation to achieve and what the operating cost reductions are.

PETRA on the other hand, aligns renovation scenarios not only with investment costs, but also with operating expense reductions, with references to various energy standards (ex. MINERGIE, energy labels) and legislations.
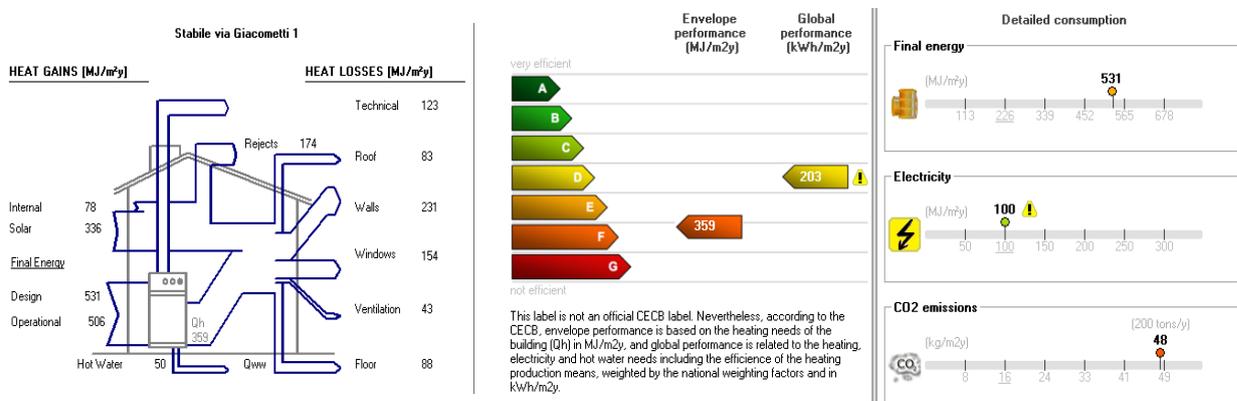

Figure. 4 : Energy balance (SIA 380/1 norm) aligned with the cantonal energy building certification by the new online tool PETRA

4. Discussion

The major challenge of the project was to develop a new decision making online support tool with unique features. Indeed, the existing methods in this area are on the one hand very precise but long to set up; on the other, there are tools that analyze the building fairly quickly, but they are not destined to professionals but rather to the wider public with results that are not linked to norms nor to a reliable database. Therefore, the new tool had to be able to give quick (two or three days per simple building) results on building conservation state and renovation scenario costs with a reasonable accuracy (+/- 15%).

The uniqueness of the new tool is also based on it's simple access and the database's update. The tool has a universal development potential by the access via all online computers. This also facilitates the updating of the tool that can integrate the user's data via a control system that structurally "feeds" the new database.

Here, the diagnostic work on building conservation state and renovation scenarios has a holistic vision of the issue. Renovation costs are linked to specific features of the analyzed building and to normative contexts concerning energy consumption, security, accessibility and heritage (cantonal regulations and energy standards). All these aspects are reported and taken into account in an investment financial analysis. Once the data insertion is complete, the user obtains an instant report and has therefore access to a complete and quantified vision of the renovation of his building or building estate.

Finally, users are able to work online benefiting from the expert knowledge of other professionals who are connected by the new competence centre through the online platform.

5. Literature/references

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