



Energy Efficient Refurbishment for Existing Office Building in UAE

توفير الطاقة عن طريق تجديد مبنى مكاتب قائم في الإمارات العربية المتحدة

By

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Dissertation submitted as partial fulfillment of
MSc Sustainable Design of the Built Environment

Faculty of Engineering & IT

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December 2011

Abstract :

UAE has witnessed a rapid economic growth in last two decades resulting in construction of large number of new buildings. With pace of new constructions slowing down following global financial crisis of 2008, focus now has shifted to efficient management of the large pool of existing buildings. One of the key components of efficient building management is to reduce operational energy consumption. Improving energy efficiency of the buildings by sustainable refurbishments can result in substantial reduction of operational energy consumption. Though energy efficient refurbishments have been successfully used to over past few decades in Europe, North American and other developed nations, the concept is relatively new in UAE and rest of Middle East region. The aim of the current study is to investigate feasibility of sustainable refurbishment intervention in existing built stock in UAE in an environment friendly and economically viable manner.

The main principles of sustainable refurbishment are to improve the living conditions and to provide user-friendly spaces, increasing flexibility of the whole building and its parts according to the current and future needs of the inhabitants. The other principles are to decrease the energy use and related operational expenses while to increase use of environment-friendly materials and renewable energy sources. In order to determine the feasibility of energy efficient refurbishments in the region, a case study approach was adopted in which a representative set of office buildings were considered for the study. Upon preliminary screening a B+G+5 storey office building built in mid nineties was chosen as base building for the study. The building was simulated using IES-VE 6.2 (Integrated Environmental Solution) tool and annual energy consumption was estimated. Accuracy of the simulation of determined by comparing estimated energy consumption with actual as-measured utility bills.

In the next phase of the study, base model was modified by incorporating appropriate refurbishment techniques and resulting energy consumption was determined by simulation. Only passive refurbishment techniques were considered for the study while active techniques have been excluded. The results from the simulation suggests that net saving in cooling loads up to 11.79 %, 9.89 %, 3.11 % and 12.96% can be achieved by application of external insulation, glazing replacement, roof retrofit and external shading respectively. The suggested passive refurbishment strategies collectively results in 29.91 % reduction in annual cooling load and 14.90 % reduction in annual operational energy consumption. Economic analysis of the refurbishment strategies suggests that net pay back period varies between 8.7 to 10 years, which is considered to be acceptable period.

ملخص:

شهدت الإمارات العربية المتحدة نمواً اقتصادياً سريعاً في العقدين الماضيين أدى إلى إنشاء عدداً ضخماً من المباني الجديدة. ومع تباطؤ وتيرة الإنشاءات الجديدة في أعقاب الأزمة المالية العالمية لعام 2008، تحول التركيز الآن إلى الإدارة الفعالة لمجموعة كبيرة من المباني القائمة. ومن أهم عناصر الإدارة الفعالة للمباني هو ترشيد استهلاك الطاقة التشغيلية. حيث أن تحسين فعالية الطاقة من خلال التجديدات المستدامة يمكن أن يسفر عن ترشيد كبير في استهلاك الطاقة التشغيلية. وعلى الرغم من استخدام تجديدات الطاقة الفعالة بنجاح على مدى العقود القليلة الماضية في أوروبا وأمريكا الشمالية وغيرها من الدول المتقدمة، يعد المفهوم جديد نسبياً في الإمارات العربية المتحدة وباقي منطقة الشرق الأوسط. لذا تهدف هذه الدراسة إلى بحث قابلية تنفيذ التدخل بالتجديد المستدام في مجموعة المنشآت القائمة في الإمارات العربية المتحدة على نحو صديق للبيئة وقابل للتطبيق اقتصادياً.

تتمثل المبادئ الرئيسية للتجديد المستدام في تحسين الظروف الحياتية وتوفير مساحات مواتية للمستخدم، مع زيادة مرونة المبنى بأكمله وجميع أجزائه وفقاً للاحتياجات الحالية والمستقبلية للسكان. وتتمثل مبادئ التجديد المستدام أيضاً في ترشيد استخدام الطاقة واستخدام النفقات التشغيلية ذات الصلة، وفي الوقت عينه، زيادة استخدام المواد الصديقة للبيئة ومصادر الطاقة المتجددة. وسعيًا لتحديد قابلية تنفيذ التجديدات الفعالة للطاقة في المنطقة، تم تبني منهج دراسة الحالة وفيه تمت دراسة مجموعة مباني أعمال نموذجية لدراسة الحالة. في مرحلة الفرز المبدئي، تم اختيار مبنى مكون من طابق أسفل الأرض (بدروم) + طابق أرضي + خمسة طوابق، والذي تم إنشاؤه في (الحول IES-VE 6.2 منتصف التسعينيات، وأُخذ هذا المبنى كأساساً للدراسة. تمت محاكاة المبنى باستخدام أداة البيئية المتكاملة)، ثم قُدر الاستهلاك السنوي للطاقة. وتحددت دقة المحاكاة من خلال مقارنة استهلاك الطاقة المقدر بفواتير الخدمات الفعلية المقاسة.

في المرحلة التالية من الدراسة، عُدل النموذج الأساسي من خلال إدخال تقنيات تجديد مناسبة حُدد الاستهلاك الناتج للطاقة بالمحاكاة. تم فقط بحث التجديد السلبي للدراسة، بينما استبعدت التقنيات الفعالة. تُؤكد نتائج الدراسة أنه يمكن تحقيق صافي توفير في أحمال التبريد يصل إلى 11.79% و 9.89% و 3.11% و 12.96% من خلال العزل الخارجي واستبدال الزجاج أو الواجهات الزجاجية وتعديل السقف والتظليل الخارجي على التوالي. وأسفرت استراتيجيات التجديد السلبي إجمالاً عن تخفيض في حمل التبريد السنوي بنسبة 29.91% وترشيد في الطاقة التشغيلية السنوية بنسبة 14.90%. يشير التحليل الاقتصادي لاستراتيجيات التجديد إلى أن صافي فترة إعادة ما تم دفعه تتراوح ما بين 8.7 إلى 10 سنوات، وهو ما يُعتبر فترة مقبولة.

Acknowledgements:

Firstly I would like to express my sincere gratitude to Prof. Bassam Abu-Hijleh for his continuous guidance and suggestions throughout the dissertation period. I also would like to express my sincere thanks all BUID faculty and staff for their support during the course.

Many thanks to my family and friends for their encouragement . Special thanks to my employer M/s John R Harris & Partners- who have continuously supported by academic endeavors. I would also like to express my gratitude HSBC-ME for providing as-built information during initial phase of dissertation.

Finally thanks to all my colleagues in BUID for their company during the course and making it memorable.

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