

Ministry of Higher Education and Scientific Research
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Faculty of Graduate Studies and Scientific Research

**The Effect of the Thermal Insulation and Building
Orientation in Reducing the Shortage of Electricity in Port
Sudan City**

**A Thesis Submitted to the Faculty of Graduate Studies and Scientific
Research in Fulfillment of the Requirements of the Degree of MSc in
Mechanical Engineering**

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September 2018

Abstract

The climate of Port Sudan city is affected by its geographical location, where temperatures rise during the summer. In summer the temperature exceeds 45 °C. The average temperature in the year is about 28.4 °C.

Cooling loads in buildings have impact on electric power consumption in the summer, where the electricity shortage in Port Sudan in 2017 recorded about 50%.

Considering a room measuring 4 x 4 x 3 meters, according to the building materials used in Port Sudan by using a computer program (Chvac - Commercial HVAC Loads), based on the data of the climate of Port Sudan, analyzed the effect of weather and geographical conditions on the thermal loads gained by the buildings and then determine the cooling capacity required to maintain human comfort.

Three different conditions were studied for the room. In the first case if the room is built on the ground and the room is exposed to the sun from all directions without insulators. In the second case, the roof and the southern wall exposed to the sun and the rest of the walls facing the shade. The third one is the same of second case but the roof is isolated.

When applying the first case the gained thermal energy was 2247 watt/hour and the cooling capacity was 3144 watt/hour. In the second case the gained thermal energy was decreased from 2247 watt hour to 1700 watt/hour, by reduction of 24.3%, and the cooling capacity was 2479 watt/hour. In the third case, the gained thermal energy decreased from 1700 watt/hour to 1004 watt/hour by reduction of 31%, and the cooling capacity was 1636 watt. The cooling system selected from Copeland Company, was suited to cooling loads to determine the consumption of electric power for each case. It was found that the third case is the best chosen, because it saved about 42% in electricity consumption compared to the first case, and about 29% compared to the second case.

المستخلص

يتأثر مناخ مدينة بورتسودان بموقعها الجغرافي حيث ترتفع درجة الحرارة خلال فصل الصيف، يمكن أن تتجاوز درجة الحرارة 45 درجة مئوية في فصل الصيف. متوسط درجة الحرارة في العام حوالي 28.4 درجة مئوية.

احمال التبريد في المباني لها تاثير كبير في استهلاك الطاقة الكهربائية في فصل الصيف حيث وصل عجز الكهرباء في مدينة بورتسودان في عام 2017 حوالي 50%.

تم اعتبار غرفة بأبعاد 4 X 4 X 3 متر حسب مواد البناء المستخدمة في مدينة بورتسودان باستخدام برنامج حاسوبي (Chvac-Commercial HVAC Loads)، بمعلومية بيانات المناخ لمدينة بورتسودان، تم تحليل اثر الطقس والظروف الجغرافية على الاحمال الحرارية المكتسبة بواسطة المباني ومن ثم تحديد احمال التبريد المطلوبة لحفظ درجة حراره الراحة للانسان.

تمت دراسة ثلاثة اوضاع مختلفة للغرفة، في الحالة الاولى إذا كانت الغرفة مشيدة على سطح الأرض والغرفة معرضة للشمس من جميع الاتجاهات ولم تكن معزولة حرارياً. في الحالة الثانية كان السقف والحائط الجنوبي معرض للشمس وبقية الحوائط مواجه للظل، الحالة الثالثة إذا تم عزل السقف للحالة الثانية.

عند تطبيق الخيار الأول كانت الطاقة الحرارية المكتسبة من الغرفة 2247 واط/ساعة والقدرة اللازمة للتبريد 3144 واط/ساعة. وفي الخيار الثاني وجد ان الطاقة الحرارية المكتسبة من الغرفة تنخفض من 2247 واط/ساعة إلى 1700 واط/ساعة بنسبة انخفاض 24.3%. والقدرة اللازمة للتبريد 2479 واط/ساعة. وفي الخيار الثالث، تنخفض الطاقة الحرارية المكتسبة من الغرفة من 1700 واط/ساعة إلى 1004 واط/ساعة بنسبة 31%، وقدرة التبريد 1636 واط/ساعة. تم اختيار منظومة تبريد من شركة كوبلاند مناسبة لاحمال التبريد لتحديد استهلاك الطاقة الكهربائية لكل خيار، وجد ان الخيار الثالث هو افضل خيار حيث يوفر في استهلاك الطاقة الكهربائية بنسبة تقدر بحوالي 29% مقارنة بالخيار الثاني و 42 % مقارنة بالخيار الاول.

Dedication

To my beloved mother ...

To my dear brothers ...

To my colleagues and friends Derby ...

To everyone who taught me ...

Give this research.

Acknowledgements

Thanks and gratitude:

Firstly, I would like to express my sincere gratitude to my advisor Dr. Mohammed Al-Mubarak, for the continuous support of my MSc study and related research, for his patience, motivation, and immense knowledge. His guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better advisor and mentor for my MSc study.

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