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A1_5 Nightclub energy

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Abstract

In this paper we have examined how much heat all the students who attend the weekly student night would generate. We have calculated the maximum energy generated to be 4.19 x 10^9 Joules. The various ways that this energy could be converted into something more useful have been considered. The assumed usable energy is 1.257 x10^9 J which would be sufficient to power the electrical systems at 'Let's Disko' with the excess contributing to the reduction of heating costs.

Introduction

Every Wednesday night students from across the university gather together to dance at the O2 Academy for 'Let's Disko'. Would this event ever be able to sustain itself from the heat of the people inside it dancing?

It was first discovered by glass blowers hundreds of years ago that heated glass tubes could produce sound. A project called the Thermal Acoustic Piezo Energy Conversion (TAPEC) has been working on ways to convert heat into electricity [3].

Heat can first be converted into sound by using metal tubes with insulating fibres inside. A temperature gradient applied across the tube will result in a change in air pressure, and consequently an acoustic wave will be produced and travel through the tube. The waves will bounce back and forth and as they will have the same frequency, resonance will occur.

Piezoelectric devices are then used to convert sound into electricity. The sound waves that have been produced can exert a pressure on the devices which produces an electrical current.

Another use of the energy generated by a nightclub full of students would be to follow the example of the Scottish nightclub SWG3. This nightclub is going to be using BODYHEAT technology [4].

It operates by using geothermal heat pumps which can be a 'ground-source or water-source' [4]. Heat is transferred from the club floor to the ground where it is stored until it is needed later on – in the case of SWG3 650 feet into the ground. The heat is collected through air collectors in the ceiling. As a result of this technology SWG3 has been able to use 70 % less electricity and no gas boilers to provide heat during the winter.

Theory

The average human body will generate 712 BTU/hour during periods of medium activity [1]. 1 W is equal to 3.41 BTU/h. Therefore for a period of medium activity a human will generate 208 Watts of power.

The maximum capacity, c_{max} at 'Let's Disko' is 1,600 people [2].

Therefore the total power generated when at maximum capacity can be expressed as:

$$P_{total} = c_{max} \times P_{individual} \tag{1}$$

The opening hours for 'Let's Disko' are 11pm - 3:30 am. We will assume that the average attendee doesn't stay there from beginning to end, but will stay for approximately 4 hours.

To calculate the total energy generated over the course of a 'Let's Disko' we will use the following equation:

$$E_{total} = P_{total} \times t \tag{2}$$

where t is the time spent at the nightclub by the average student.

We will assume that 30 % of excess energy created by the dancing students has been able to be converted into something useful. This is because a large amount of the energy will not be able to be captured and reused.

A typical 'Let's Disko' set up will include the sound system, heating for the building, two large music video screens, disco lights and laser lights. The sound system will require a power wattage of 16,000 Watts [5]. The power required to power the video screen is 90 Watts [6]. The lighting system requires 18,000 Watts [7].

Results

To calculate the total amount of power generation Eqt. (1) was used. The power generated at maximum capacity was 332,800 Watts. Using Eqt. (2) the total energy generated over the course of an evening was calculated to be 4.19 x 10^9 Joules.

If 30% of this heat was collected it would produce 1.257 x10^9 J.

If it was possible to convert this into electricity then it could be used to power 29,097 disco balls with a wattage of 3 Watts for 4 hours [8].

On a more practical note we will consider how much of 'Let's Disko' the excess energy from the attendees will be able to power. The total power needed to provide power to the electrical systems will be 34,180 Watts.

The power produced from the heat at maximum capacity over 4 hours is 87,291 Watts. One the electrical systems have been powered this will leave 53,111 Watts which can be used to heat the building. Whilst this might be not be enough energy to provide enough heat for the building, it would considerably reduce the amount of electricity required to heat the building.

Conclusions

In conclusion if the excess energy from a maximum capacity 'Let's Disko' was utilised it would be able to provide enough power to supply the electrical systems with enough energy to power for the duration of the event.

References

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