Rebecca S. Allen
Mechanical Option

The Palestra Building
London, England

ASHRAE Standard 90.1 Report

I. Executive Summary

The purpose of this report is to take a closer look at the mechanical structures of the Palestra Building looking at the design's environmental consciousness according to the LEED program, power consumption densities according to ASHRAE Standard 90, lost rentable space due to mechanical systems, fuel utilization data, emissions, and load and energy analysis. A comprehensive analysis can then be completed with respect to 'the bottom line': money. And comparisons can be made with similar projects of scope and size to ensure efficiency on the project.

The Palestra Building was designed to qualify for a 'Very Good' rating on the BREEAM scale, which is the UK's equivalent to the US's LEED initiative. Palestra received 57% of the points on the BREEAM scale (57points of a possible 90 points), but only received 42% of the points (29 of 69 points) according to LEED. With 29 points the Palestra Building is certified as a LEED building, but it does not qualify for the Silver, Gold, or Platinum certifications.

The envelope was found to be compliant with ASHRAE Standard 90.1. The Palestra Building was found to have 44.3% glazing on its façade which is less than the 50% maximum as stated in Standard 90. The façade's shading coefficients were also calculated with the maximum values for the North façade being 0.36 and all other sides being 0.25. The glazing on all sides of Levels 0-8 (the 'Bottom Box') and the North side of the Levels 9-12 (the 'Top Box') complied with the Standard, while the South/East/West facing areas on Levels 9-12 did not pass with a value of 0.34 > 0.25.

The lighting consumption of Palestra was also calculated according to ASHRAE Standard 90. According to the 'Space by Space' method outlined in the Standard, only four of the six typical spaces divided by activity passed. This included the water closets, reception area, plant room, and corridors. The spaces that did not pass were the Office Space (15.75 W/m^2 > 11.83 W/m^2) and below grade Car Park (3.5W/m^2 > 2.15W/m^2). According to the 'Building Area Method' analysis, the power overall lighting power density for the building I 14.75 W/m^2 which is significantly greater than the 10.7 W/m^2 (1.0 W/ft^2) maximum value outlined in Std. 90. The Palestra Building does not comply with ASHRAE Standard 90's lighting power density regulations.

The Palestra Building has a rooftop chiller plant, a basement boiler plant, and an additional major mechanical space on the ground level to service the lobby area. It was found that 10.56% (3450.11 square meters) of the building's gross internal area is lost due to these systems. The design team was aiming for a value between 6 and

11% for mechanical spaces, so while this is on the higher end of the range it is still considered 'good design.'

The Palestra Building's mechanical systems contain 4 gas-fired boilers, where three run at full capacity and one is for redundancy. There are also 7 packaged chillers, with 6 running at full capacity. Each chiller has an electrical consumption of 186kW. The total gas intake for the Palestra Building is 212 m^3/h. Through a full building simulation using Carrier's Hourly Analysis Program (HAP) version 4.20, it was found that the design tonnage and supply rate (cfm) per air handling unit were comparable with the HAP output. However the ventilation rates for the units serving the office spaces according to HAP were double the rate of the design flow. This suggests a difference between the American and British building assumptions and will be discussed further in the conclusion.

The design peak loads for the Palestra Building are 1796kW (heating), 3871kW (cooling), and 3051kW (electrical). The natural gas intake is sized at 212 m^3/h, providing 6.64E+06 Therms per annum. Each of the seven chillers is also sized to provide 157 tons of air conditioning each. To accurately calculate the emissions for the electrical generation mix in the UK, the following percentages were used
Coal: 34%, Oil: 2%, Natural Gas: 37%, Nuclear: 23%, Hydro/Wind: 4%. The final pollutant concentrations were found to be 3.49E+4 lbm of SO_x, 1.64E+4 lbm of CO_2, and 7.24E+6 of NO_x.

Finally, the operational and first costs for the mechanical systems were calculated. The building's mechanical first costs came in at £9.9 million which is 15% of the total project cost. According to the HAP cost analysis the annual operating costs will average £200,000 annually. These values are based on the assumption that the building owners will choose to use British Gas as their electrical and gas supplier. With such a large commercial consumer, the nominal rate could improve.