A comprehensive model was developed to analyse the performance of different air-conditioner (A/C) control strategies of an educational building in a hot summer environment. The main objective of the study was to evaluate thermal performance of the existing A/C control system to identify the causes of uneven temperature profiles in classrooms, and to assess alternative control systems in terms of their ability to achieve thermal comfort as well as optimal levels of energy consumption. The performance of four conventional (on/off) control strategies and two advanced control systems (namely Proportional and proportional-integral-derivative (PID)) was evaluated. An important distinctive characteristic of this study is how close the simulation represents reality in terms of building details, external and internal heat flow sources and mechanisms, explicit representation of controllers, and the integration approach of the building and its heating, ventilating, and air conditioning system in TRNSYS simulation environment. The resulting comprehensive database includes detailed time variation of temperature, humidity, cooling load, and thermal comfort indices corresponding to variable occupancy size and duration. Results showed that conventional A/C design practices may be deficient in certain occupancy cases and that control systems based on using only one thermostat in each building section are inadequate. Quantitative energy consumption for an individual-room control system capable of maintaining temperature and thermal comfort levels in all rooms within the design limits was determined. This provides a basis of cost estimates for solving the existing problem of uneven temperature distribution in classrooms and was used as a reference for assessing the energy cost of other more advanced control scenarios. Both Proportional and PID control systems are shown to be capable of maintaining temperature levels in all rooms within the design limits. Relative to the conventional individual-room control system, slightly more energy consumption (by 2.3%) for the Proportional system and slightly less energy consumption (by 2.3%) for the PID control systems were determined. Peak load reduction of close to 14% is achievable using the Proportional control system, and up to 8% is expected when using the PID. These peak load savings are relative to the individual-control system, which is 14% lower than the existing system.