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### Een nieuwe omgang met comfort

*De invloed van innovaties in verwarming en ventilatie op het ontwerp en gebruik van gebouwen, 1840-1920*

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## 9 Summary: A new approach to comfort

### *The effect of innovations in heating and ventilation on the design and use of Dutch buildings in the nineteenth century*

Central to this study is the way in which new ideas on health and comfort, as well as technical innovations in heating and ventilation, have influenced the design and use of nineteenth-century residential and public buildings in the Netherlands. The nineteenth century was one of great social, cultural and technological progress, profoundly changing daily life. Innovations in structural, architectural and mechanical engineering, including the introduction of steam power and electricity and the development of new building types, were of great influence on the built environment. These innovations, together with scientific discoveries and new, progressive ideas on health (predominantly regarding clean air), introduced by physicians and hygienists around 1800, created new standards for living. Due to their use, public buildings had more urgent issues with the indoor environment than residential buildings, and therefore were the first to demonstrate this new technological approach to health and comfort. Although the introduction of building services in public buildings had different architectural and spatial consequences, derivatives of these developments were introduced in the design of upper-class nineteenth-century residential structures as well.

During 1840-1920, an integral approach to comfort was developed, in which not only indoor air pollution was considered, but also air temperature, air velocity, relative humidity and radiation pattern; all in order to realize a healthy and comfortable indoor climate. The indoor climate was initially put on the agenda by medics and hygienists, as well as some architects involved. At the same time, the field of engineering developed strongly, with growing attention to the subject in architectural education. Basic conditions for a healthy and comfortable indoor climate were drawn up and discussed extensively in trade journals, together with international examples of buildings equipped with modern climate systems. In the second half of the nineteenth century, the market for heating and ventilation systems had also grown significantly. As a result, a wide range of options for heating and ventilating buildings emerged. In addition to fireplaces, stoves and natural ventilation – methods that had been used for centuries and remained popular on a large scale in the nineteenth century – central heating and ventilation systems were also launched onto the market. Hot air, steam and hot water were the main methods for central heating, occasionally in combination with forced ventilation or as hybrid systems.

The proper system was primarily determined by the typology and nature of the building, and thus technical and functional requirements were imposed on the system. However, in order to design a properly functioning climate system, it had to be integrated in the architecture of the building. Various design factors played an important role, such as

orientation, shape and volume of the building, the main structure and thus the position of the various rooms in the floor plan, the layout of the facades, the use of ventilation towers and chimneys, and open gas lighting. The relationship between these design factors and the specifications of the various heating and ventilation systems was complex, and unique for each situation. Hot air heating and forced ventilation in particular had a major impact on the design of the building, partly due to the large bricked-in channels that were necessary to distribute air. Bricked-in furnaces, fuel storage facilities and humidifying and foul-air chambers also took up space in the building. Moreover, these systems were less flexible, certainly in comparison to hot water heating. Intensive collaboration between architects and engineers was therefore an important requirement for the proper functioning of climate systems in the nineteenth century.