> The standard of requirements has equally been raised, as to degree as well as to permissible variation in temperature . . . under structural conditions growing more and more adverse. Certain unpleasant experiences with some of the thin, tall and flimsy buildings now being erected, and not even suited to their purpose, will serve to illustrate this difficulty.[2]

[2] Meier, op. cit., p 4.

It is not common nowadays to think of the pioneer skeleton-frame skyscrapers as 'tall, thin and flimsy' and it is therefore sobering to reflect that famous works of architecture, such as Burnham and Root's Reliance Building, would fit comfortably into the class of buildings of which Meier complained. By comparison with the massive masonry structures of earlier decades, they were quite light enough to introduce novel 'unpleasant experiences,' though their deficiencies are less effectively summarised by Meier than by Bushnell and Orr in their textbook on district heating, where they refer to

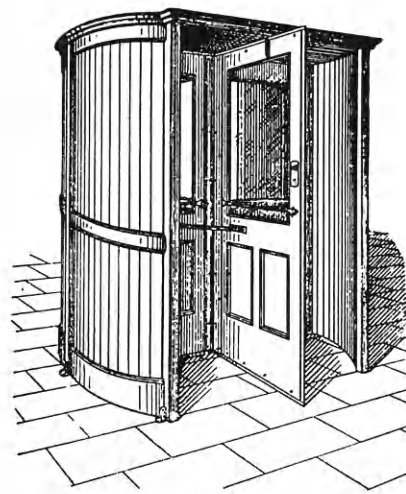
> . . . a skeleton or framework of steel columns and girders, enclosed by a brick wall and finished on the outside with brick or terra-cotta tile. With such tall buildings it is necessary to use the lightest material available in order to decrease the weight on the steelwork and foundations. In doing this, of course, the thinness of the walls becomes of importance from the standpoint of heating calculations. Such buildings have little capacity for storing or retaining heat, which is in contrast to what is found in buildings of massive masonry. In the former case—the modern building—heat must be furnished for a much longer daily period than the latter, due to the more rapid cooling effect. Furthermore, the modern structure is designed with a view to utilising as much of the exterior as possible for window-space, as by so doing the lighting conditions are vastly improved. In fact, some buildings are practically 40% to 45% glass area, and the heat loss from such buildings is proportionately high . . .
>
> One peculiarity which has been noted sometimes in very high structures is the draft effect due to the inrush of cold air through openings on the lower floors. The air, on being heated rises rapidly through the various elevator and ventilation shafts, and causes a partial vacuum effect, with a useless expenditure for heating the large volume of air.[3]

[3] Bushnell and Orr, op. cit., p 207.

The nuisance value of this thermal siphon effect in tall buildings went beyond waste of heat however: the suction could pull in bad weather and street dirt at ground level, could make doors difficult to manage, and whisk papers from desks. The ultimate solution was to be controlled mechanical ventilation of a sealed building envelope, but a simple and ingenious Victorian solution was to hand by the end of the eighties—the revolving door. This was hardly a novel invention, but it was in this period that it was brought to its present level of operational perfection and was made a piece of standard equipment, specifiable ex catalogue, and it was for these refinements that Theophilus van Kannel received the John Scott medal of the Franklin Institute in Philadelphia in 1889. The van Kannel Company's slogan 'Always Closed' ('a person passing through the door pushes any one of its four wings forward, the wing behind him arriving at the curved side wall before the wing in front leaves it') explains well enough why their catalogue[4] could claim better ventilation control and greater uniformity of temperature within the building as a consequence of using their revolving door. It was an effective environmental filter that admitted persons but not the wind, a draught-lock if not an air lock, that strangled violent up-currents at birth.

[4] Van Kannell catalogue of 1901.

Such timely innovations, however, could not entirely deal with all the environmental problems of large buildings. Nor could innovations in their structural form do as much as might have been hoped, especially where constraints upon the plan were imposed by the nature of the site—that is to say, very little could be done to the architectural design of skyscrapers to improve their environmental performance while they stood tall upon such small sites; their faults derived from the economic and urbanistic situation that caused them to be built in a tall and narrow format. Radical mechanical improvements were to be the only solution, but it would be some time before mechanical plant had been sophisticated to the point where it could be installed in skyscrapers without cutting away so much rentable floor-space as to cancel any economic gain that might have accrued from environmental improvements.



The van Kannel revolving door unit in its most inexpensive and basic form, 1900.

On less constricted sites, innovations in the forms of large buildings could come some way to meet the environmental technology then available, and together they could offer significant improvements. Two outstanding examples may be cited from the first years of the present century, both motivated by an external climate containing a local excess of pollutants. In both of them architectural form and almost complete conscious control of the internal environmental conditions are inextricably entangled, but there resemblance ends—their architectures could not be more different. The less progressive in architectural style, but more advanced environmentally of the two, is the Royal Victoria Hospital in Belfast, Northern Ireland. At face-value, the credit for its design goes straightforwardly to the Birmingham architectural firm of Henman and Cooper, with Henry Lea as their engineering consultant, but a fog of rumour has always surrounded the design, because local pride insists that the whole concept is too original to chime with the rest of Henman and Cooper's work, and at first sight it must appear strange that in a city where the forced ventilation of ships was a technological habit, and where Samuel Cleland Davidson's Sirocco works was producing some of the world's most advanced centrifugal fans, neither influence should have had any apparent direct effect upon the design. Davidson's, it is clear, were responsible for the design, installation and subsequent maintenance of the heating and ventilation machinery, and if their influence on the architectural concept was not direct, it could still have operated more obliquely through Davidson's own business and social connections. Shipping and ship-building interests were strongly represented on the hospital's board of management (as on most other things in Belfast) and the suspicion that some of them may have talked the architects into the final bulk form of the building is heightened by thinly veiled accusations[5] that the discussion at the Royal Institute of British Architects which followed the presentation of the design by the architects, was rigged and deliberately talked out of time by the scheme's supporters in order to prevent awkward questions being asked.

[5] correspondence in *The Building News* (and elsewhere) 1903–1905. The original presentation of the building (still a fundamental document) and the subsequent discussion at the RIBA are reprinted in *RIBA Journal*, Vol. XI, 3rd series, 1903–1904, pp 89*ff*.