#6492

Within these walls

by Ken Dale

The model prison at Pentonville, built by Sir Joshua Jebb in the mid-1800s, is undergoing refurbishment. Ken Dale looks at the building services engineering of this pioneering structure.

With Christmas approaching, it may seem an inappropriate time to celebrate the 150th anniversary of the building of a prison. The excuse for doing so is to bring to the attention of present day building services engineers the work of a remarkable Victorian engineer, Sir Joshua Jebb.

The prison which he designed and built at Pentonville is still in use today. Modifications are now in progress and so Pentonville is likely to remain in use, basically as Jebb conceived it, for many decades to come.

Pentonville model prison and Jebb

Jebb, at the time a Major in the Royal Engineers, selected the site in 1840. He then produced the designs for the prison, including its building services, and supervised the construction and commissioning. The building was complete by September 1842, and was first occupied on 21 December of that year.

The 560-inmate prison became known as the Model Prison, and the model was used at home and abroad. Jebb himself oversaw the building of many similar prisons and after the first prisoners were installed at Pentonville, Jebb became chairman of directors of convict prisons. In 1859 he was knighted for his work.

Jebb's report[1] on the building of Pentonville and its first two years of operation forms the basis for this article. It was translated into French and German and was widely read by prison reformers in America.

The total area of the site was about six acres, with a garden at the rear. Four cell blocks, three storeys high, radiated from a central hall behind the chapel. Each cell was 13 x 7 feet, rising to a height of 9 feet.

A fourth storey was later added to the cell blocks, increasing the capacity to about 1150 individual cells, and clerestory lights were incorporated into the new roofs. The building works increased the extent of the site to around 10 acres.

Besides the chapel there were houses for the governor, chaplains, 19 prison officers, a schoolmaster, a clerk of works and an engineer. Eight bathrooms, a kitchen, medical facilities, offices, library, store rooms and heating plant rooms were also provided.

The whole complex cost around £90 000 which, with £1 in 1841 being the equivalent of £38.86 nowadays, works out at £3 500 000 at 1992 prices. Price per cell was £167, or £6490 per cell at 1992 prices.

The building services element of the cost of the works was somewhere between £10 500 and £11 000 (£427 500 at 1992 prices), or 12% of the total cost.

Heating and ventilation

One of the major concerns of services engineers nowadays is that of indoor air quality. Jebb was very concerned about this; he was firmly convinced that the quality of ventilation of a cell had a direct influence on the health of a prisoner, and was therefore one of the most important factors in prison design.

He also felt that the warming of cells was necessary and inseparably connected with ventilation. His peers at the time were not so convinced.

One, a certain Captain Williams, wrote a letter to Jebb[2] in which he criticised him "for applying the luxury of heat to prisoners' sleeping quarters, the more especially as the greater portion of the honest population in the country neither experience the wont nor enjoy the possession of such advantage." Jebb, however, felt that it was neither difficult nor expensive to provide warming and ventilation, and recommended it for all new prisons.

Joshua Jebb.

The main objects of his design were:

- ☐ to withdraw a stated quantity of foul air from each cell – 30 cfm (14·2 litres/s);
- ☐ the supply of an equal quantity of fresh air without causing a draught;
- ☐ to find the means of warming the air when necessary without "injuring the qualities or affecting its hygrometrical condition" (52-60°F, ie 11-15°C, to be maintained in the coldest weather);
- ☐ that the air channels and flues should not be a means of communication between prisoners.

Jebb consulted Hadens of Trowbridge, and with them developed an apparatus for warming the air. A system of flues was designed (figure 1) to allow outside air, warmed or not as necessary, to be introduced into each cell at high level. An extract grille was placed at low level in each

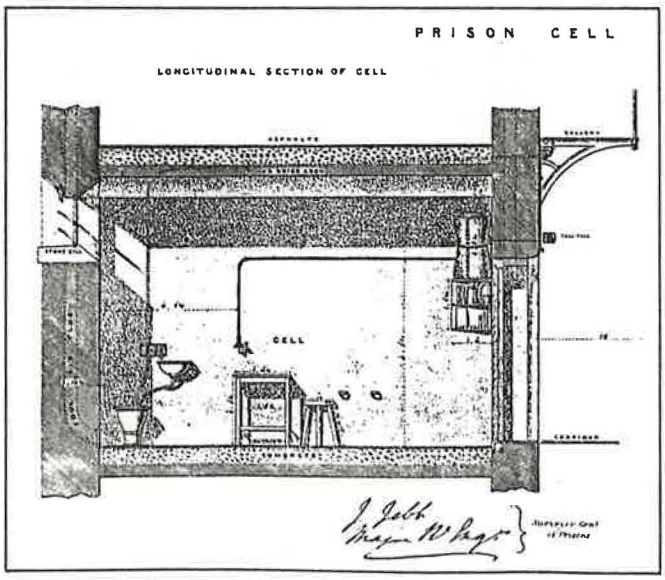

Figure 2: Each cell had its own hand basin and wc.

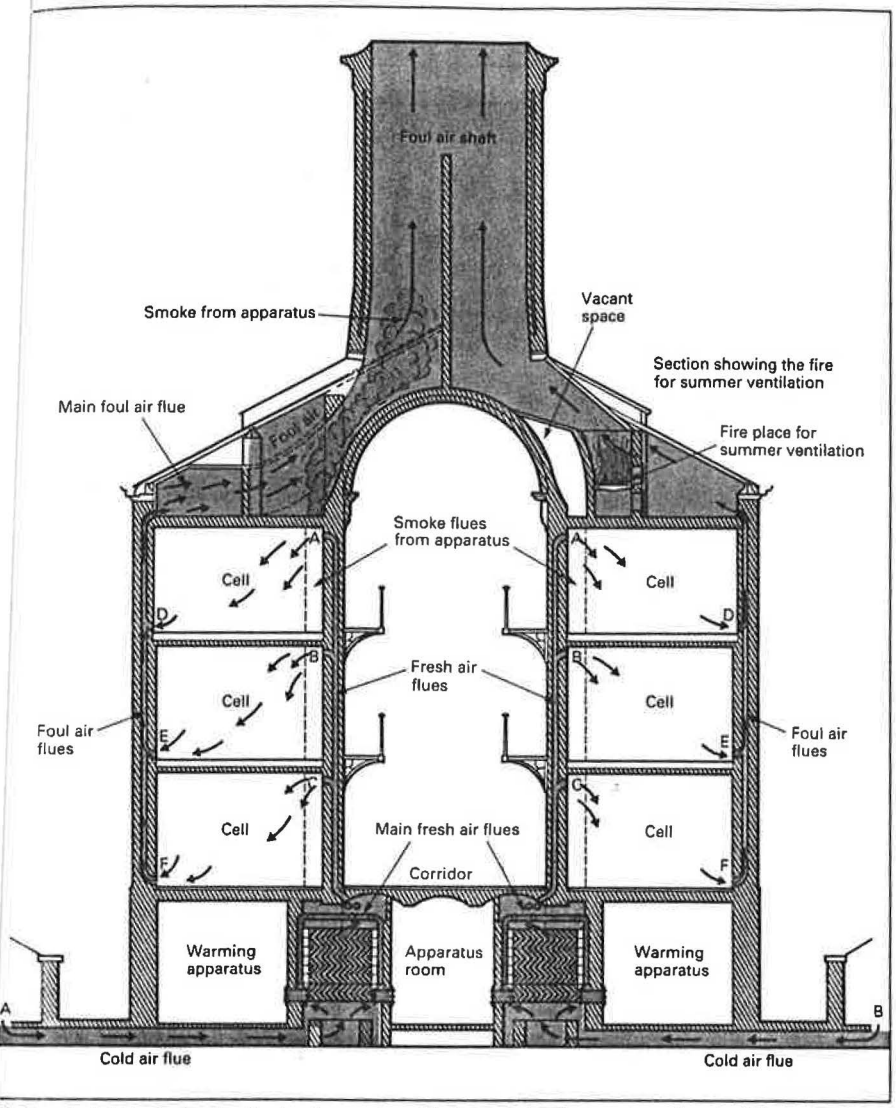

Figure 1: Jebb's design for the heating and ventilation revolved around a network of flues.

cell, and was ducted to the foul air extract in the roof.

A small fire was maintained at the bottom of the vertical shaft to induce flow in the summer. Jebb remarks that the fire was needed because wind forces alone could not be relied upon to produce the necessary circulation.

Haden's apparatus was a boiler with an extended heating surface – cast iron plates in zig-zag lines in a brick work setting. It was designed to produce 60°F at outside temperatures of 32°F using water at 100-120°F. This level of heat was chosen to avoid high entering air temperatures.

Other requirements were that temperatures should be adjustable, and that the whole apparatus should be simple in its construction so there would be no difficulty in its management.

Commissioning and testing

Whether or not the system worked was not left to chance. Dr Owen Rees, the principal medical officer, was charged with conducting trials and produced a report which showed that:

- 30-45 cfm of fresh air was supplied to each with regularity (how this was measured is not clear);
- this volume could be supplied (maintaining 52-60°F in the cells during the coldest weather) at a cost of less than a farthing a cell for 24 hours;
- the same degree of ventilation was maintained in summer at half the expense.

The Surveyor General of Prisons Costs for the year 1854/5 gives the cost of fuel and light as £700 (£27 200 at 1992 prices) for the year. With 561 prisoners, this works out at three farthings per day per prisoner.

Jebb had initially cautioned against trusting temperature or fuel consumption results until all the flues and building materials had dried out.

Washing and sanitary facilities

George IV (1820-1830) required that warm and cold baths should be introduced into all prisons. Jebb provided eight baths, enough to bathe 32 prisoners in an hour. Each prisoner bathed once a fortnight.

Surprisingly, perhaps, Jebb also provided a wash hand basin and a strong glazed earthenware pan (wc) in each cell. As figure 2 shows, water (six gallons per cell per day) for washing and flushing was provided from a cast iron sectionalised channel running beneath the galleries. Water from the basin drained via the soil pan so that it was not wasted.

When describing these provisions, Jebb cautions on the need to avoid freezing, and suggests that this can be accomplished if cisterns and pipes are placed in or near to the foul air flues and kept away from the influence of outside air.

It is unclear at what point in the prison's history individual toilets were removed from cells and 'slopping out' became the norm, but it is interesting to note that it is only recently that such facilities have been reinstated as part of the programme of upgrading the prison.

Lighting and communications

Jebb employed Mr Faraday to provide gas-producing apparatus and light fittings to each cell, as well as the prison buildings. The lighting point in the cell can be seen in figure 2. Each point had a shade.

Though prisoners were not allowed to communicate with one another, it was considered essential that they should be able to gain the attention of the prison officer at any time. For this purpose, each cell had a handle attached to a spindle with a metal label at the gallery end. The label was normally horizontal but when it was turned vertically it indicated the prisoner's need for attention.

Nowadays design teams and contractors who manage to design and construct a building in 3 to 4 years talk of the project as being fast-track. Even though planners were probably not around to delay matters for Jebb, that he managed with his contractors and suppliers to build, fit-out and commission a prison for 560 offenders in 18 months was no mean achievement.

It makes you think why we, with the technology and machinery at our disposal today, take so long to produce buildings.

Readers will discern that Jebb was well ahead of his time in being concerned about indoor air quality, fuel consumption/energy conservation, public health engineering and the commissioning of the services he designed.

It is also striking that Jebb and his contemporaries put considerable emphasis on recording what they had done and how they did it, so that a record and guidance was available for others to follow and for us to contemplate 150 years on.

Ken Dale OBE TD CEng HonFCIBSE HonMAICVF is senior partner of Dale and Goldfinger Consulting Engineers.

References
[1] "Report of the surveyor general of prisons on the construction, ventilation and details of Pentonville Prison", HMSO, 1844.
[2] "Jebb papers", British Library of Political and Economic Science.