



**Sir JOSHUA JEBB RE
1793-1863**



Surveyor-General of Prisons



[204] Major Joshua JEBB

active 1850

English military officer. Royal Engineers. Responsible for the design and construction of Pentonville Prison (1840-1842), London. This was considered a landmark, both in the design of the prison itself and in its services.* He employed Haden [223] to assist with the design and to carry out the installation, which included for the boiler feed water to be pumped by hand by 12 men in the cells. Jebb wrote, "An equable temperature of from 52°F to 58°F has been maintained in all the cells under circumstances of great variation in external temperature. The consumption of fuel has not exceeded from 2 to 2-1/2 cwt of coal for sixty-six cells, and the ventilation or quantity of fresh air introduced into each cell has been from 30 to 45 cubic feet per minute. The cost of maintaining this temperature and ventilation has been about 1/2 d per cell for 24 hours."

He also noted, "the greater fuel consumption in a newly-built structure which has not thoroughly dried out." The tradition of Royal Engineers' prison-building was carried on by Du Cane [196].

(From "The Comfort Makers," Brian Roberts, ASHRAE, 2000)

4.3.4 Pentonville Prison

Major Jebb designed a system of heating and ventilating for Pentonville Prison in 1840: he described it in a paper of 1844. It was a landmark in the technology, and seems to have been adopted by General Morin for many large public buildings in France. The core of the installation is the boiler and heat exchangers (Fig. 4.14). Fresh air is drawn via underground ducts to the heating coils, and then to main horizontal warm air flues. Vertical risers, with a branch to each cell, ascend from these flues. Vitiated air is drawn via low level extract grilles from each cell into a common foul air shaft which joins the boiler smoke flues at attic level. A fireplace in the attic provided the power for foul air extraction in summer. The firm of G. N. Haden sent to Jebb a drawing showing how the boiler feed water could be pumped by hand by 12 men in the cells: this was later installed in a number of prisons.

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Jebb saw that the difficulty of ventilating prisons by opening windows:

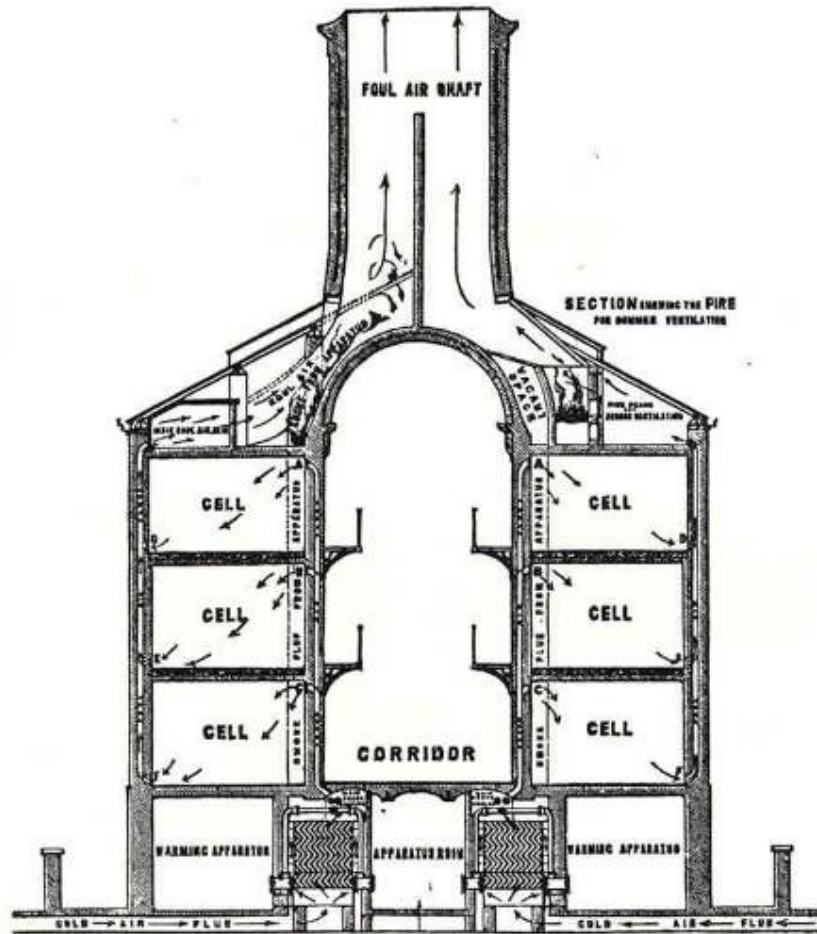
"arises from their being destructive of discipline, in favouring the transmission of sound; and this has been the one great difficulty to contend with."⁽³³⁾

A series of tests was carried out by the Principal Medical Officer, who established that from 50 to 76 m³/h of fresh air was supplied to each cell "with extraordinary regularity". This ventilation, and a temperature of from 11 to 15°C can be maintained in the coldest weather, for less than a farthing a cell a day.

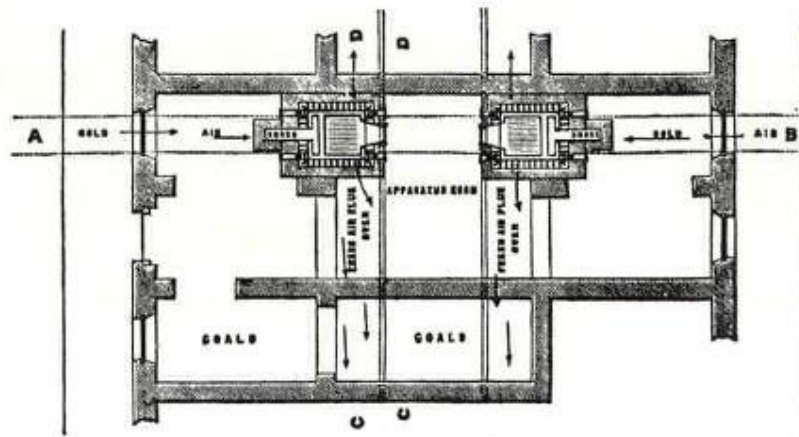
Jebb noticed a fact which is often overlooked: the greater fuel consumption in a newly-built structure which has not thoroughly dried out. "Hence", he says, "the necessity of not trusting any results in connection with the power of an apparatus until all the flues and the building are perfectly dry".

The first cost of Jebb's scheme was (according to Constantine) enormous. A similar plant was installed at Glasgow University in 1865. The building served had a volume of slightly over 56000 m³. The installation cost £17000, and maintenance was £500 a year. It consumed 2.15 tonne of fuel per day. Professor James Thompson said it was only moderately successful, but the originally proposed cold fresh air supply to classrooms had been omitted.

(From "Building Services Engineering," Neville S Billington & Brian M Roberts, 1982)



SECTION OF PENTONVILLE PRISON.



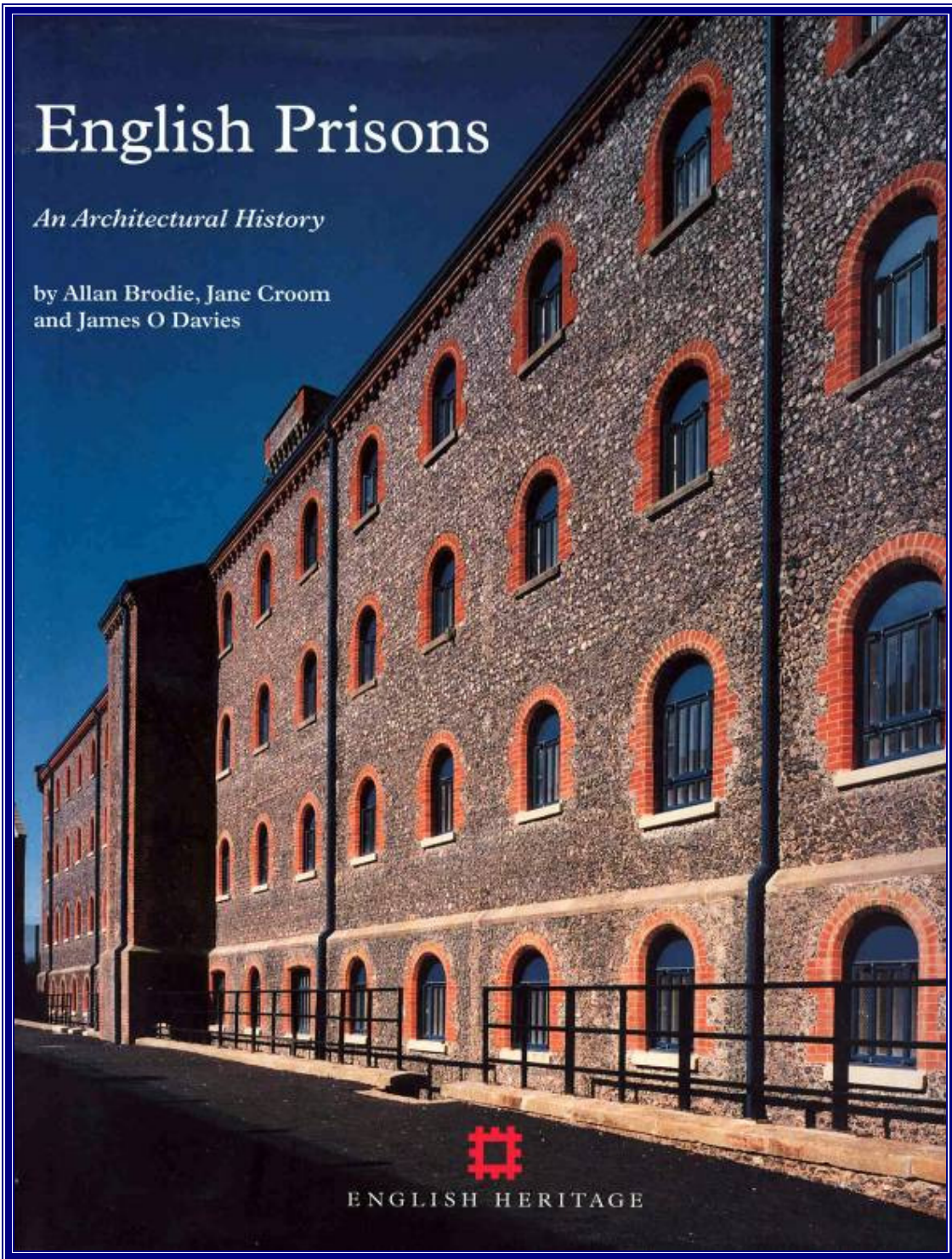
PLAN OF APPARATUS ROOM.

Heating & ventilation systems for Pentonville Prison

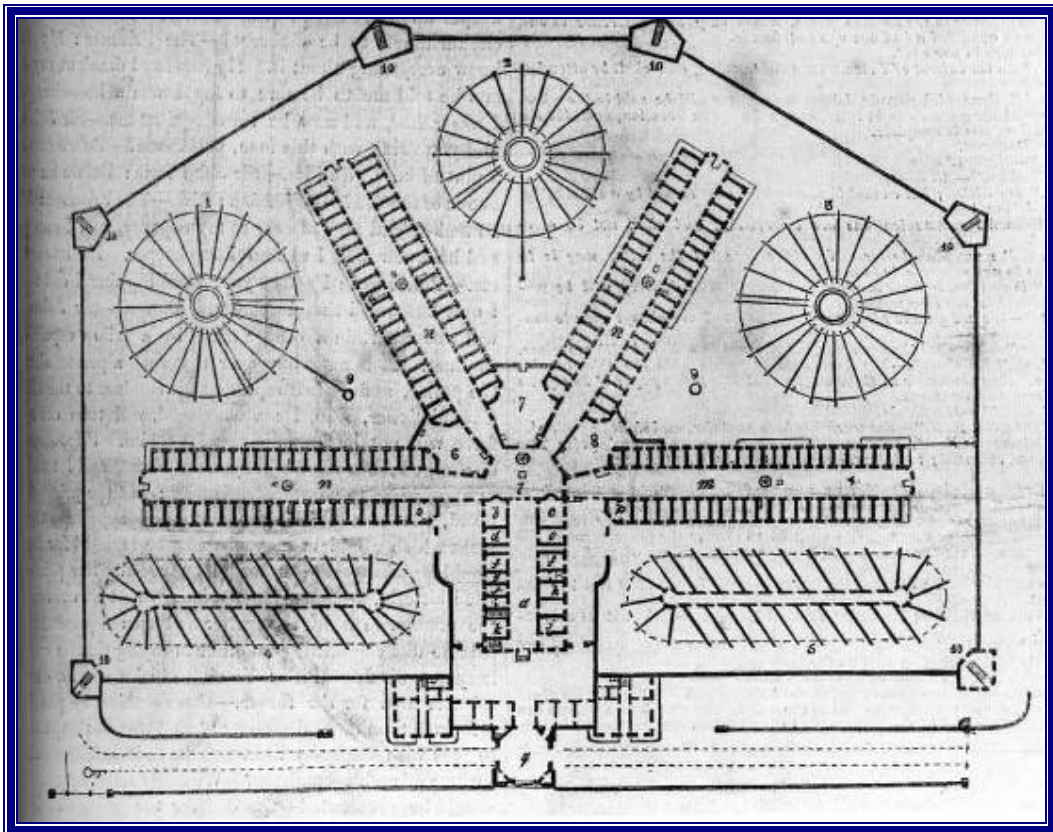
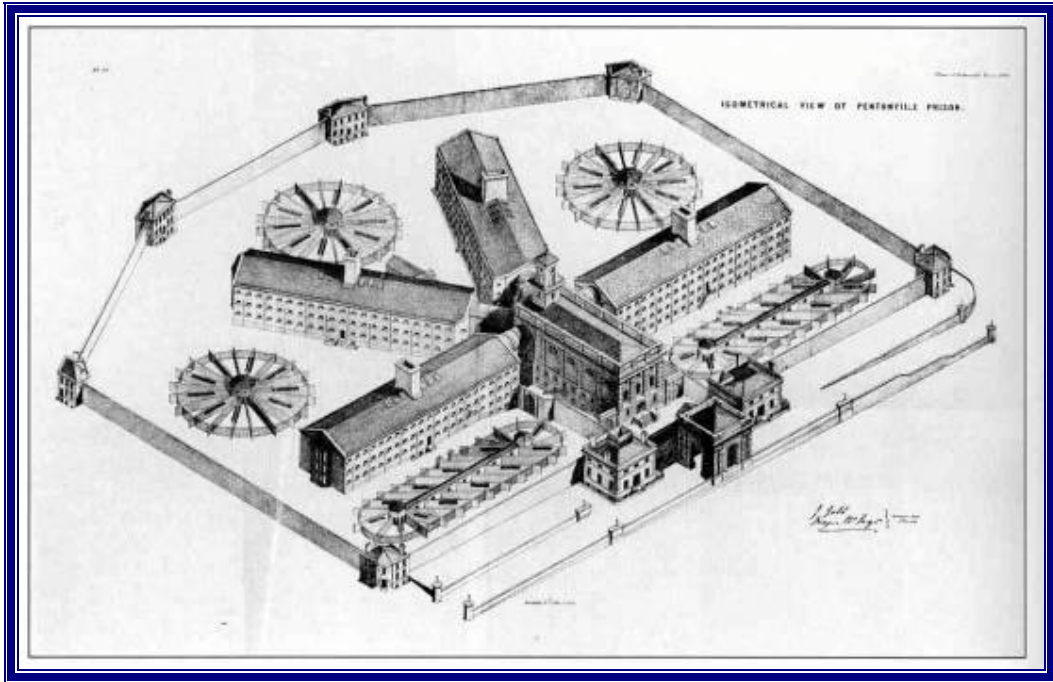
English Prisons

An Architectural History

by Allan Brodie, Jane Croom
and James O Davies



"English Prisons," 2002 (CIBSE Heritage Group Collection)



Pentonville from "English Prisons"

REPORT.

*To the Right Hon. Sir James R. G. Graham, Bart.,
Secretary of State for the Home Department.*

SIR, *45, Parliament-street, August 8, 1844.*

AGREEABLY to your directions, I beg leave herewith to submit detailed plans of Pentonville Prison, showing various improvements which have been effected during the construction of the building, and the different Fittings which have been adopted.

With reference to the special objects for which this prison was designed, viz., to be a model of Construction, and to be appropriated for carrying into effect the Separate System of discipline, it is satisfactory to me to submit the following extract from the Second Report of the Commissioners for the Government of the Prison, appointed by Her Majesty under the Act of the 5th Vict., cap. 29.

Pentonville Prison, March 10, 1844.

State of the Buildings.

“ THE experience of the past year has justified the opinion which we have already expressed, that the construction and general disposition of the buildings are calculated to facilitate the administration of the discipline in all its branches.

“ The cells and different fittings in them, the chapel, the exercising-yards, the means of supplying each prisoner with water, and of conveying the provisions for distribution, are all found to answer their desired ends.

“ The perfect ventilation of the cells, and the means of maintaining an equable temperature, independent of sudden changes in the external atmosphere, has been most successfully accomplished. The system is found to be altogether so effective in its operation, and is maintained in constant action at so trifling an expense, that we cannot too strongly recommend its general adoption.

“ During the past year the prison has been completed in many essentials, which could not be satisfactorily determined until after its occupation. The cells have been fitted up for carrying on various trades, such as carpenters, joiners, implement-makers, turners, weavers, rug and mat-makers, shoemakers, tailors, and basket-makers. The necessary machinery or fittings have been placed in the cells, which have been found to be in all respects conveniently adapted for workshops.

Under all these circumstances, whilst endeavouring to anticipate every contingency of Discipline likely to affect the question of Construction, I have considered it my duty to guard against any expenditure which did not secure means for the immediate or prospective adoption of a system involving the individual separation of prisoners.

The progress hitherto made in erecting prisons to combine these advantages has been most satisfactory. I propose, Sir, to bring under your notice, in a subsequent Report, Plans of the principal Prisons adverted to, and to notice any improvements which further experience may have suggested. In the mean time it may be sufficient to mention, that whatever has been the size of the prison, or the immediate object of its erection, all have been executed on one uniform principle of Construction which will sooner or later lead to greater uniformity in Discipline.

I cannot conclude without availing myself of the opportunity of representing to you, and of acknowledging, the invariable cordiality and attention I have experienced from the Magistrates when engaged under your directions in advising with them on subjects connected with the construction of prisons, and affording such assistance as lay in my power.

I have the honour to be,

Sir,

Your most obedient

Humble servant,

J. JEBB, } *Surveyor-General*
Major Rl. Engineers, } *of Prisons.*

SECOND REPORT

OF THE

Great Britain -

SURVEYOR - GENERAL

OF

PRISONS.



Presented to both Houses of Parliament, by Command of Her Majesty.

LONDON:

PRINTED BY W. CLOWES AND SONS, STAMFORD STREET,
FOR HER MAJESTY'S STATIONERY OFFICE.

1847.



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.

"Within These Walls," Ken Dale, Building Services (CIBSE Journal), December 1992

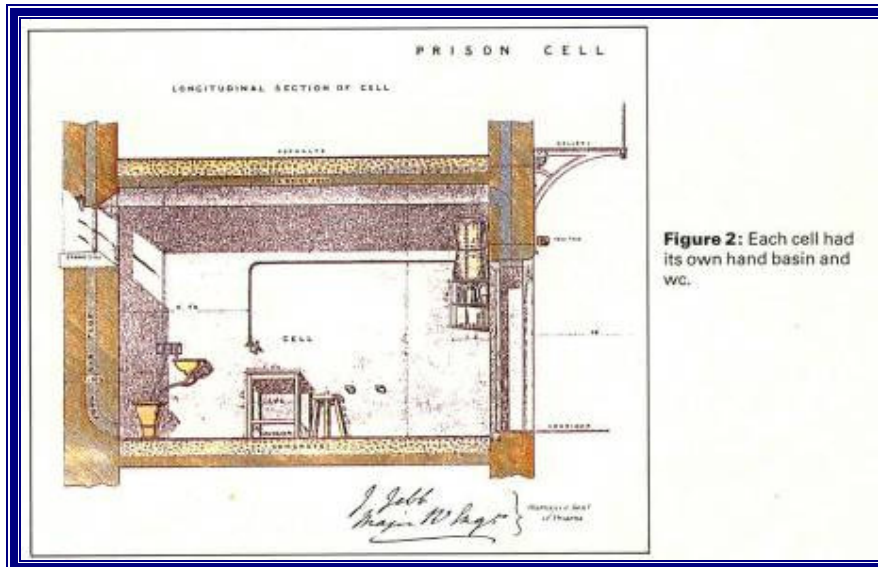


Figure 2: Each cell had its own hand basin and wc.

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 report¹ 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 13x7 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.

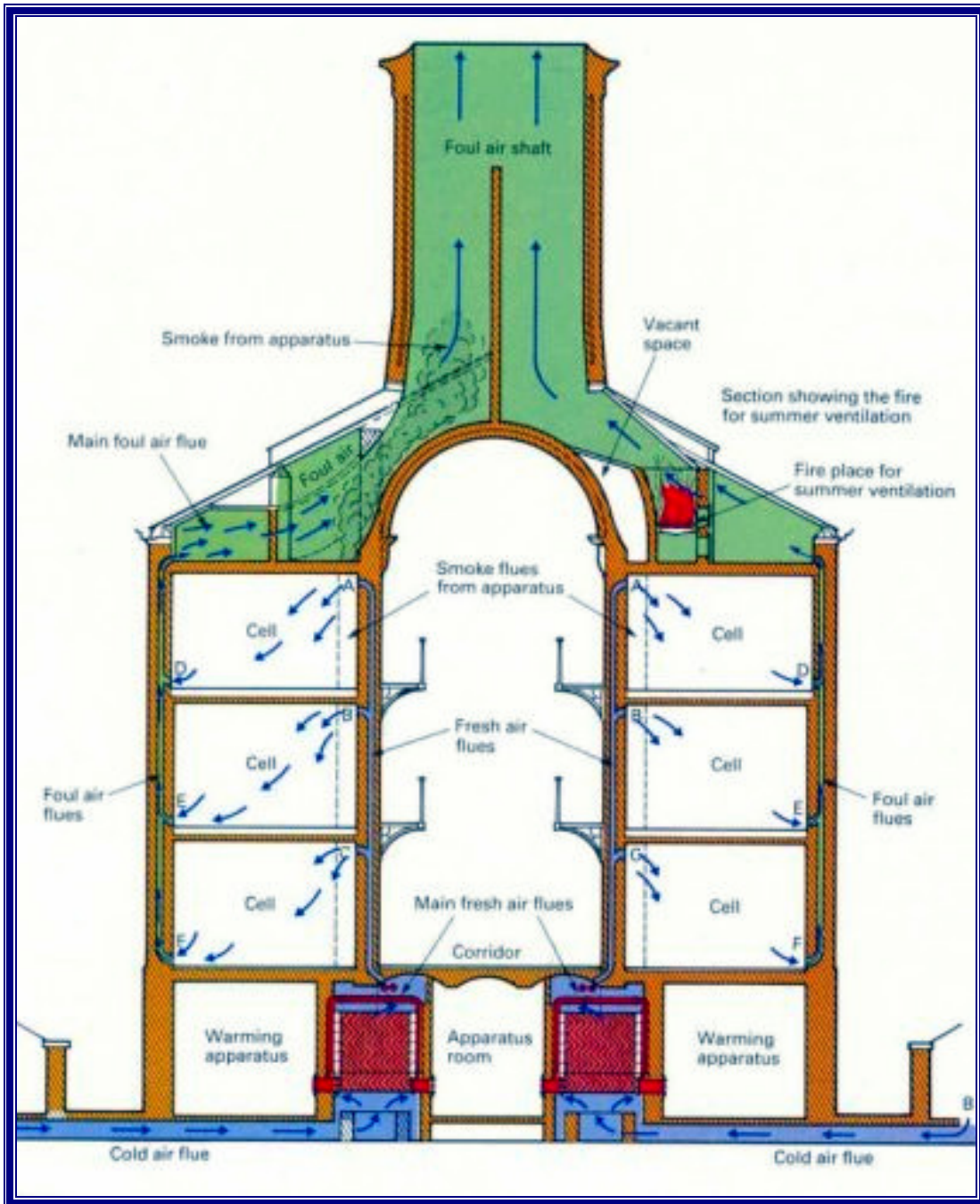
One, a certain Captain Williams, wrote a letter to Jebb² in which he criticised him “for applying the luxury of heat to prisoners’ sleeping quarters, the more especial-

ly as the greater portion of the honest population in the country neither experience the want 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.

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



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 (main-

taining 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 pans 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.

COPY OF TESTIMONIALS

REFERRING PARTICULARLY TO THE

VENTILATION AND WARMING OF PRISONS.,

Extracts from 3rd and 4th Reports of the Inspectors of Prisons for the Home District, presented to Parliament in the years 1838, and 1839.

VENTILATION OF CELLS.

The objects to be attained under this head are,

1st. The supply of a sufficient quantity of fresh air and when necessary, of tempered air, into each cell without subjecting the occupier of it to any inconvenience from the draft.

2nd. The withdrawal of a like quantity of foul air.

3rd. That no additional facilities of communication between prisoners in adjoining Cells should be afforded by the means made use of.

In the consideration of the means by which these objects could be secured, we have had the advantage of the practical experience of those eminent Engineers, MESSRS. HADEN, of TROWBRIDGE, who on being placed in possession of our views and principles have devoted much time to the details of a system which has been adopted in order to secure the conditions proposed.

Their Report on the subject is annexed in the Appendix of 3rd. Report, November, 1837.

(Signed)

WM. CRAWFORD
WHITWORTH RUSSELL } Inspectors of Prisons.
J. JEBB, Captain Royal Engineers.

Copy of a Letter from Major Jebb, Royal Engineers.

45, Parliament Street,
17th February, 1843.

MESSRS. G. AND J. HADEN,

Gentlemen,

I have now had sufficient experience of the new hot water Apparatus you have designed and applied in warming three wings of Pentonville Prison, to be enabled to state to you that it fulfils all the conditions to which I directed your attention. An equable temperature of from 52° to 58° has been maintained in all the Cells under circumstances of great variation in external temperature. The consumption of fuel has not exceeded from 2 to 2½ cwt of coal for sixty-six Cells, and the Ventilation or quantity of fresh air introduced into each Cell has been from 30 to 45 cubic feet per minute. The cost of maintaining this temperature and ventilation has been about ¼d. per cell for 24 hours.

You have now completed your contract with the Commissioners of Her Majesty's Woods and Forests, for works at Pentonville; and I only do you justice in stating that every thing you have undertaken has been executed in a manner which has proved your practical skill and ability and that all your engagements have been fulfilled with straight-forward integrity.

I am, Gentlemen,

Your Obedt. Servt.

(Signed)

J. JEBB.