01

Location: *Nicholson Street, Carlton, Victoria*

Trustee: *The Trustees of the Royal Exhibition Building*

Architect: *Reed & Barnes*

Builder: *David Mitchell*

Constuction Date: *1880*

written by: *Susan Ferguson* | **with:** *Greg Nolan* | **design:** *Peter Walker*

The Royal Exhibition Building

Carlton, Melbourne - Victoria

Melbourne's Royal Exhibition Building, erected for the Melbourne International Exhibition of 1880-1, is one of Australian most prominent and historic public buildings. It is a monumental structure that stands in the Carlton Gardens near the centre of Melbourne as a testimony to the Victorian spirit of enterprise and industry in late nineteenth century Australia. The building, now graced with a Royal Charter, was also the setting for the Federation ceremonies in 1901 that marked the birth of Australia as a nation. As the venue for many events and exhibitions during its long life, the building and garden surrounds represent an important link with Australia's cultural life.

Designed by noted Australian architect, Joseph Reed, it is a fine early example of the use of timber in the structure and finish of a large classical style building in Australia. Architectural features include the Florentine dome, deep arched doorways and the classical edifice, considered to be Reed's finest. The main building, the hall with its dome and transepts, is all that remains of the original complex, which included two large annex wings and a variety of temporary structures. Today, the building is acquiring a new partner, with construction of the new Denton Cocker Marshall designed Victorian Museum within the adjacent gardens .

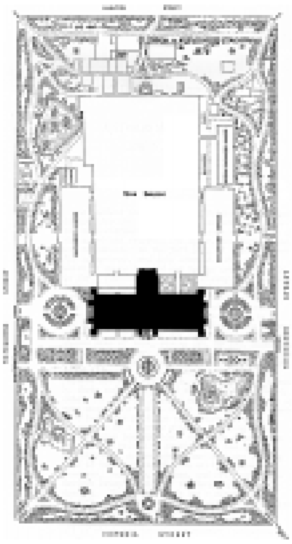
top right
main entry to exhibition building - the iconic Florentine dome is a landmark to Melbourne
photo - Peter Greenwood Brown

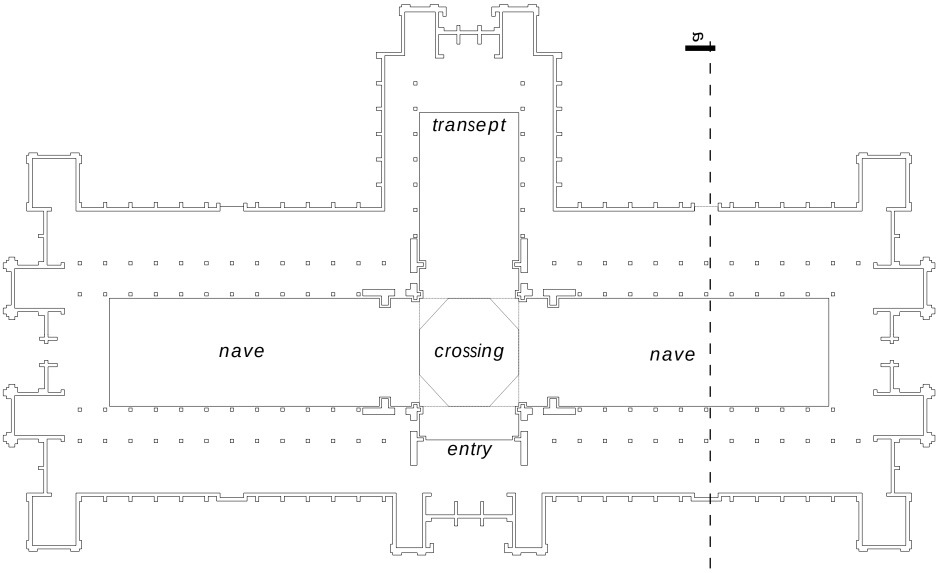
main image
interior of the western nave (looking eastward)
photo - J. Abell

- **Description -** The main building, erected in line with Gertrude Street, Fitzroy has a frontage of 151m to the principal walk across the gardens. The deep archway of the main entrance, that faces south to Spring Street, is capped by a fanlight 12.1m in diameter and flanked by towers that rise 30.3m. Beyond and above the towers, the dome rises to 66.6m. At tower level, enclosed by parapet walls is a terrace, originally designed for promenading around the dome. The interior volume comprises a long and commanding nave and more modest transepts. Both are flanked by aisles and overlooked by continuous and well lit galleries. The crossing of nave and transepts is dominated by the inner ceiling of the octagonal dome, and its supporting buttresses, pendatives and drum. The columns, floors, ceilings and structure of the nave, transepts and crowning dome are all constructed of timber while the surrounding facades and dome supporting structure are masonry.

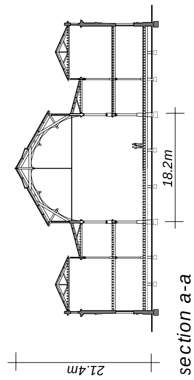
All of the internal timber work, except the naturally finished floors, was originally richly painted in Victorian patterns and colours. Now restored, this gives a sense of movement and gaiety to the building while punctuating many of the otherwise flat surfaces, and reinforces the long lines and vista of the nave. It works to make the interior of the building appear larger and more grand.

- **Structural Description -** Notwithstanding the powerful lines of the dome externally, the dominant structure upon entering the building is the long roof and supporting lines of columns in the nave and transepts. The main and repetitive roof elements are tied **trussed arches** that spring from the top of each of the solid Oregon columns in the upper gallery tier. The trussed arches support the exposed roof and ceiling structure of under-purlins, rafters and a board lined ceiling. Columns in the lower tier and further lines of columns behind them support the timber framed and boarded floors of the aisles and galleries. These are in turn roofed by both skillion and king post trusses.

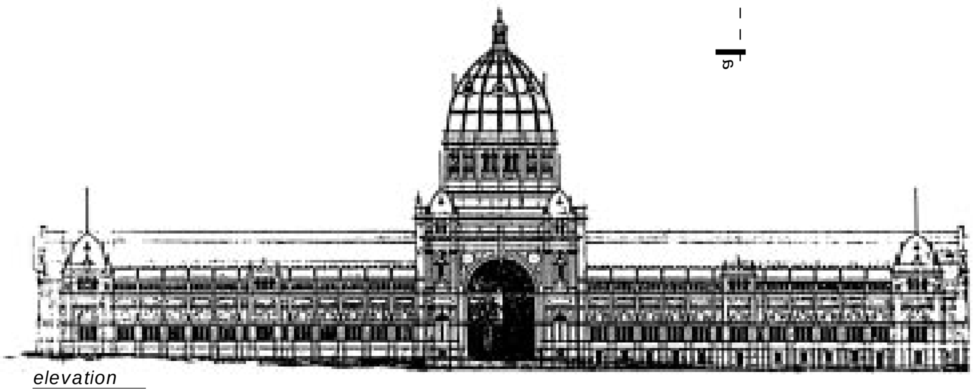




plan



section a-a



elevation

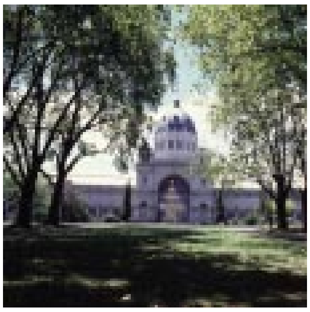
top right
plan of original exhibition complex and garden (remaining building shown in black)

middle right
perspective of Reid and Barnes original design drawings - courtesy of the Melbourne Exhibition Building Trust

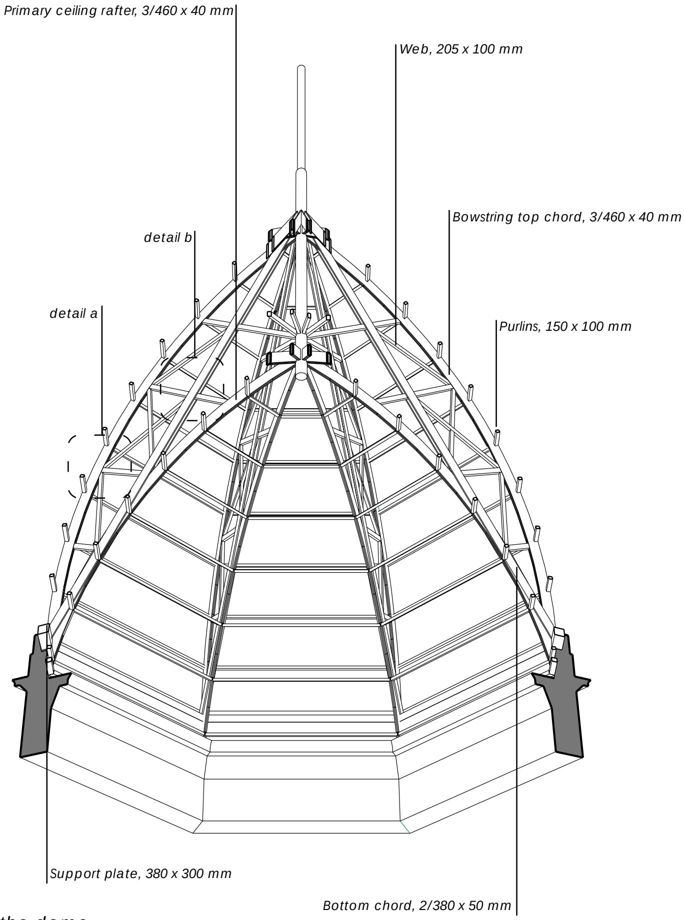
top left
first floor plan of exhibition centre

above right
section a-a

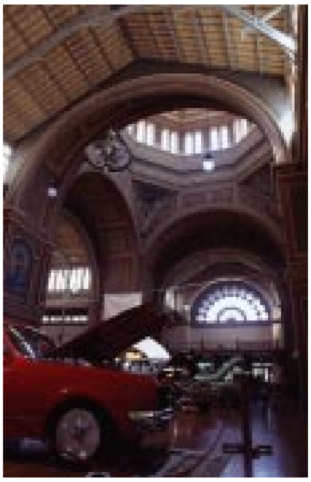
above left
front elevation (towards Victoria St.)

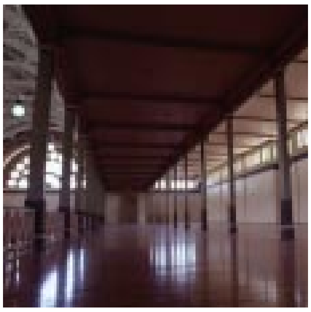


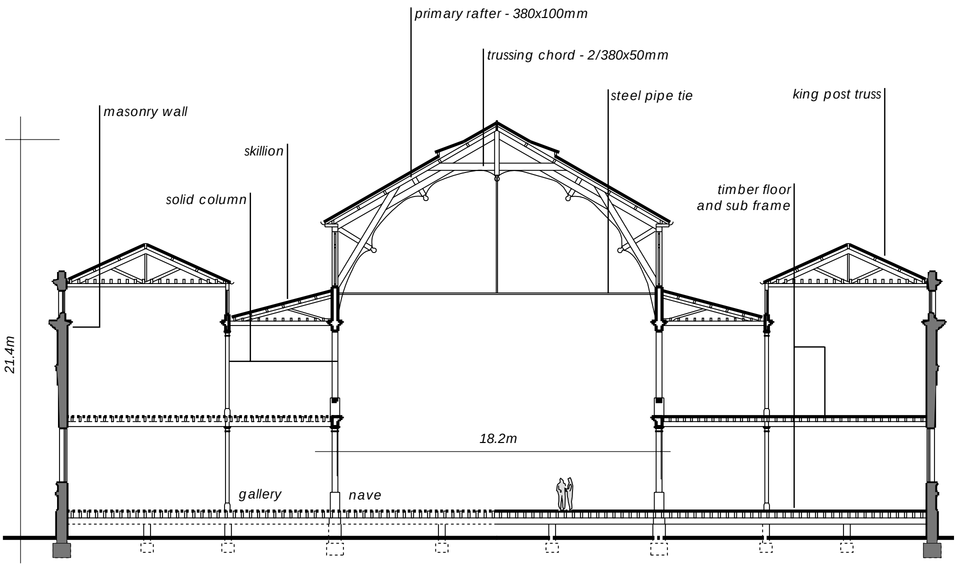
Unlike Brunelleschi's masonry dome for Florence's cathedral of Santa Marie del Fiore, Reed's dome is not a true compression dome. Like St Paul's Cathedral in London, it includes an inner suspended ceiling and an outer dome skin that are supported from a simpler internal structure. In the Melbourne building, eight large **bowstring trusses** *are fixed to a post at the top and tied together at their base with a circular timber tension ring. To achieve the curved shape of the dome ribs externally, the top chords of the truss were constructed from three layers of sawn Oregon boards laminated together to form a segmented curve. The straight bottom chords of these trusses run either side of the* **webs** *in two full length pieces, each 19.7m long. The inner dome is suspended from these trusses and comprises curved primary ceiling rafters, purlins, battens and a board lined ceiling.*



the dome







section a-a

It is clear that the architects intended to create a grandeur in the nave and transepts with the light timber arches of the roof structure echoing and accentuating the large contiguous arches of the dome supports. However, their attempt to leave the space below the arches clear of obstruction appears to have quickly come undone. The trussed arches of the nave and transept were not originally tied and their design relied on the bolted truss joints of the members to resist spreading. This proved inadequate and movement in the base of the arches forced the top of the supporting columns to spread. To limit this, the bottoms of the arches were tied with steel pipe some time between the international exhibitions of 1880 and 1888.

top left
view of entry and dome of exhibition building - it is a symbol of the utopian face of the industrial revolution at the end of the 19th century.

top right
perspective of the timber framing of the dome

middle left
the crossing of the nave & transept at the base of the dome.
photo - J. Abell

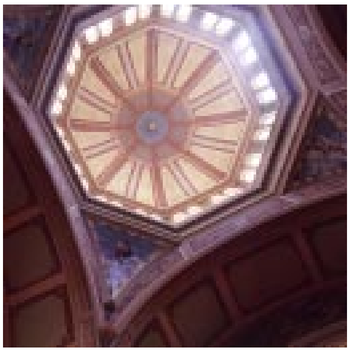
bottom left
the low timber ceiling of the galleries

bottom right
detail section a-a

A strategy for design with timber

- **Economy** - The architects, Reed and Barnes, won the design competition for this building by proposing a highly economic solution to the strict budgetary conditions imposed on this project. The scheme proposed a predominantly timber structure for the bulk of the building and relegated relatively expensive masonry construction to the exterior walls.

Timber construction was lighter, faster, required smaller foundations and therefore reduced overall cost in comparison to other construction methods. It is interesting to note that when the supporting structure for the dome was changed from timber to masonry after contracts were let, the construction cost for the building rose by more than 10% of the original contract sum. The imported Oregon was only dressed where it would be touched. Otherwise, the structure was left rough sawn and members and linings were painted. In this way each layer of structure had a predetermined finish in the design and therefore a part in the painted scheme or interior decoration of the building. To control cost, a hierarchy of detailing was established in the building.

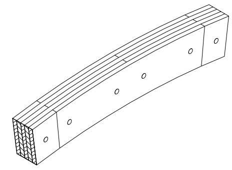


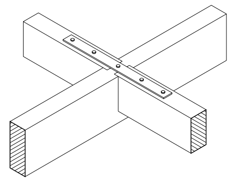
left
the bays of the galleries

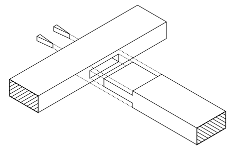
middle
timber roof trusses of nave

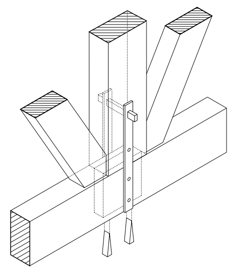
right
view up into the dome

below (top to bottom)
- curved horizontally laminated beam
- overstrapping purlin connection
- mortice & tenon joint

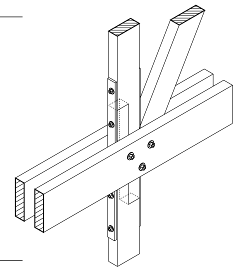








detail a



detail b

- **Timber technology and seasoning** - When the Exhibition building was constructed, the predominant timber engineering technology used in Australia was from England and used **mortice and tenon joints** in many of its connections. While adequate in compression, mortice & tenon joints make poor tension joints and most had to be strapped with steel. Members also had to be oversized as their strength was reduced by the formation of the mortice.

The majority of timber in the exposed structure of this building was imported. This is not because the local hardwoods were not strong enough, rather there was a limited understanding at the time of the most efficient ways to season Australian hardwoods. Hardwood seasons very slowly and a 75mm board may take two years to season properly. It also tends to shrink significantly and can twist as it dries. As the designers and millers of the time did not know how to control this satisfactorily, the potential use of locally sourced timber remained unexplored while the use of imported technology and materials dominated practice. In turn, this led to the acceptance of a particular aesthetic for timber buildings in later Australian practice. Drawing from rural and industrial buildings of early Australia and featuring elements such as king and queen post trusses, this was adopted in varying degrees and romanticized during the 1960's in buildings such as Tocal College, designed by Philip Cox and Ian McKay.

- **Longevity – durability and maintenance** - Although over one hundred years old, the timber structure of the Exhibition Building continues to perform adequately. Besides the additional tie rods, the only timbers that have recently required repair work are the timber base plates of the dome where flashings and gutters deteriorated and water penetrated the structure. This has caused decay in the timber joints.

Moisture penetration is the most common cause of deterioration in buildings. All buildings require active maintenance regimes to ensure that the breakdown of flashings and roofing, changes in ground level and damage to downpipes and the external fabric of the building do not compromise the internal structure. This particularly applies to timber buildings, especially those of this age, where any breakdown in the external fabric can result in the members being continually wet. This leads to decay.

- **references**

Architecture 1952, 'Joseph Reed of Melbourne', Oct-Dec., pp. 132-134.

Willingham, A.1983, The Royal Exhibition Building Carlton - A Conservation Analysis for the Exhibition Trustees, (unpub.)

- **glossary**

bowstring truss: *a truss where the top chord of the truss is curved to an arch shape*

mortice & tenon joint: *a joint where a hole or slot known as a mortice is formed in a piece of timber to receive the reduced end of similar size, or tenon, from another piece. The joint is often secured with wedges, dowels or steel plates*

trussed arch: *an arch where the main member is made up of elements aranged as a truss*

web: *any transverse lateral stiffener*

- **on the internet**

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