

Discover Engineering Heritage: Central Melbourne

*A two hour walking exploration of
engineering heritage*

Melbourne was founded in 1835 and grew very rapidly during the gold rush of the 1850s, and its heyday as Marvellous Melbourne was in the 1880s. Today it is a major metropolis housing more than 4 million Melburnians who come from many countries. More than one-in-three of us were born overseas.

Engineering has, of course, played a huge part in Melbourne's development, and this tour will explore some of the engineering heritage gems of the city. An early focus was on transport infrastructure, principally to facilitate the importation of people and goods. The wealth from the gold rush enabled the city to develop rapidly and magnificently.

We will use your feet, walking about 5 km to get to the 14 engineering heritage gems which this tour will explore.

Have fun exploring the centre of our city!



**ENGINEERS
AUSTRALIA
Victoria Division**

1. Flinders Street Railway Station

The first steam railway in Victoria was privately owned, went from Flinders Street Station to Port Melbourne, and opened in 1854. The station expanded progressively to serve further private rail lines that served other suburbs. Most lines were electrified between 1919 and 1924. The Victorian Government now controls the network via a contract with a private operator.

The first viaduct that linked Flinders Street Station with Southern Cross Station (then Spencer Street Station) was built in 1891. Further tracks were added in 1915 and 1978.

Flinders Street Station is the busiest suburban station in the Southern Hemisphere, with some 105,000 passengers using it, and some 1,500 train movements serving 199 metropolitan stations, each day.

The current grandiose building, much loved by Melburnians, dates from 1910. It was built with generous facilities for railway workers and the public, but many of these are no longer used and efforts are underway to find new uses to rejuvenate usage of the building. The main entrance has long been seen as a major focus for Melbourne life. The façade that overlooks the platforms, which appears to be constructed of stone blocks, is actually a thin lightweight wall.



2. Princes Bridge

The present bridge is the fourth on this site. The first was built in 1840, five years after the founding of Melbourne. It was a privately-owned wooden toll bridge. In 1844, a wooden trestle bridge was built, also a toll bridge.

The first permanent bridge, built of sandstone and incorporating only a single 46m arch span was completed in 1851. This bridge was designed by David Lennox and was at the time the longest single span bridge in the world.

Heavy traffic and a tendency for the bridge to act as a choke in the river and cause flooding upstream led to plans for its replacement.

A new bridge was designed by John Grainger (1855–1917), the father of the Australian composer Percy Grainger, and was built by David Munro.

Construction on the new bridge began in 1886 and it was opened on 4 October 1888, in time for the second International Exhibition to be held in Melbourne. It is a three span structure built on solid bluestone piers with wrought iron arched girders with lattice webs/spandrels. It is similar in design to Whitefriars Bridge in London. The bridge is 30m wide by 122m long and is slightly skewed.

A young John Monash worked for contractor David Munro on this bridge.

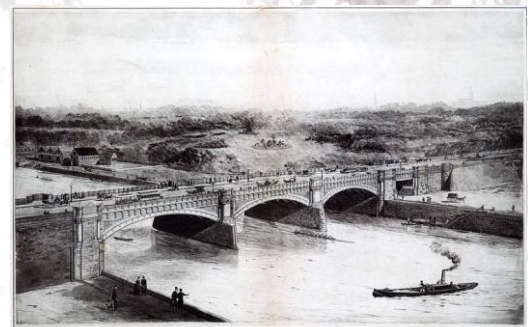


Image: H W De Moet



3. Sandridge Railway Bridge

The first bridge on the site was built in 1853 for the original Melbourne and Hobson's Bay Railway Company line to Sandridge (Port Melbourne) from Flinders Street. In 1857 the St Kilda line opened parallel to part of the line to Sandridge, and the original bridge was replaced in 1858 by a timber trestle bridge carrying two lines of rail traffic, with the tight curve of the original railway removed by rebuilding the bridge on a 33 degree angle to the riverbank as seen today.



Image: State Library of Victoria

The current bridge was designed by the Victorian Railways Department and built by David Munro & Co. The four track bridge opened in 1888. It was one of the first railway structures in Melbourne to use steel girders rather than iron. The plate girders are supported on concrete-filled cast iron columns. There are bluestone and brick abutments and on the south side the structure continued as a brickwork viaduct.



Image: Nix Pix Mix

The bridge was last used in for railway traffic in 1987 with the conversion of the St Kilda and Port Melbourne railway lines to trams. In 2006 the redevelopment of the bridge for pedestrian use was completed. Today, the bridge houses information about migration to Victoria.

4. Queens Bridge

Queens Bridge is located where, when Melbourne was founded, there was a rock shelf and rapids in the River Yarra. Just downstream is the old turning circle where ships were turned around.

The first bridge built on this site (c1860) was of timber and stone. It was unable to withstand the blasting to remove the rock bar (The Falls) that was carried out during the 1880s on John Coode's recommendation to improve river flood flows and facilitate upstream navigation.



Image: National Library of Australia

The present bridge was designed by Public Works Department engineers Cheechi and Catani and built by David Munro. It was opened in 1889. The bridge is wrought iron, continuous plate girder construction with five spans. It was designed to carry cable trams on the South Melbourne and Port Melbourne lines which were in service from 1890 to 1937, and replaced by electric trams from 1946.

The ornamental cast iron balustrades and their supporting consoles are a significant feature of the bridge.



Image: source unknown

5. King Street Bridge

Utah Construction Company won the design and construct contract for the King Street Bridge. The design was undertaken by King Street Bridge Design P/L, a company set up by Hardcastle & Richards. The bridge was built in 1960-61.

The steel girders are designed to act compositely with the reinforced concrete bridge deck. The foundations are steel-cased reinforced cast-in-place concrete piles.

The bridge is famous for having failed in 1962 when one span collapsed when a heavy truck drove over it. It was one of the first bridges to use welded high strength steel plate girders, Following a detailed enquiry the failure was attributed to the procedures used on certain welds being inappropriate for the high strength steel.

The repairs included the use of pre-stressing cables, and the pre-stressing ducts can be seen when standing on the promenade on the south side of the river.



Image: Lawrence Reddaway

6. Sewer System

By the 1880s, Melbourne had a major problem. It had gained the unfortunate nickname “Marvellous Smellbourne” and, in 1889 alone, nearly a thousand people died of typhoid. Sewage still ran in open drains and nightsoil men collected pans from back alleys and houses around Melbourne.

A relic from those early days can be seen on the Flinders Lane frontage of the hotel in the old Rialto Building: At the end of each balcony there is a corrugated iron shed, which used to house the ‘toilets’ (probably urinals) for the use of occupants on that floor.

Following a Royal Commission in 1888, the Melbourne Metropolitan Board of Works was formed in the early 1890s. Its first offices were set up in this building in late 1891 soon after the building was completed with the MMBW being an early tenant.

By 1897, the first sewerage connections were being made, and connection was compulsory.

Sewage was taken, via a network of main underground sewers and a massive pumping station at Spotswood, to a sewage farm at Werribee. Unlike Sydney, which decided to pump its sewage out to the ocean with minimum treatment, the MMBW had decided to treat Melbourne's sewage at the Werribee sewerage farm before it was released into Port Phillip Bay.

If you are interested in the Melbourne Sewerage system visit the Spotswood Pumping Station at Scienceworks.



7. Melbourne Hydraulic Power Company

In 1889 Melbourne became the fourth city in the world to have a public hydraulic power system to provide motive power for cranes, hoists, goods and passenger lifts, and other mechanical devices. A substantial steam pumping station at the Australian Wharf (later known as North Wharf) supplied water at a nominal 700psi (4.8Mpa) to cast-iron mains installed beneath the streets in the CBD.

The Melbourne Hydraulic Power Company was floated in 1887 by Coates & Co with George Swinburne as its first Engineer-Manager. The company prospered and by the end of 1889 some 70 lifts along with other customer plants were connected to the system. The hydraulic power system was compulsorily acquired by the Melbourne City Council in 1925 by which time the utility had 346 customers with a total of around 600 connected appliances. The MCC replaced the steam pumping plant with electrically driven centrifugal pumps located at its Spencer Street power station in 1928 and continued to operate the service until 1967.

The remnants of a pair of whip hoists operated by 'hydraulic jiggers' and mounted on the west wall of the former Rialto Building in Collins Street are a visible reminder of the hydraulic power utility.



8. Former BHP Building

The building on the SE corner of the Bourke/William intersection was built in the early 1970s as the headquarters of Australia's largest company (BHP). At that time, BHP produced steel, and the facades reflect the peripheral steel columns and bracing. The structural design – innovative for its time - was by Irwin Johnston & Partners.

The foundation is in the form of a continuously cast concrete raft slab, a new technique at the time. The floors are of lightweight concrete on steel decking supported on steel beams and act as a stiffening element that together with the cap and belt trusses allow the structural loads to be carried down through the outer skin of steel framing and the central services core. This afforded 'open plan' floors devoid of internal columns that became common practice in subsequent high-rise commercial buildings.

The floors, being lightweight concrete cast onto steel decking, were originally provided with fire resistance by an asbestos-based product sprayed onto their undersides. When all asbestos had to be removed from the building (for health reasons) in the early 1990s, an exhaustive fire safety analysis showed that, if upgrades were incorporated into the sprinkler system, then it would be acceptable for the floors to remain without additional fire resistance being applied, even though this meant that the floors would have a lesser-than-normal fire resistance.

The building originally contained a total energy or 'co-



Image: Melbourne Museum



Image: Wolfgang Sievers

generation' system, whose objective was to maximise the use of natural gas (a BHP product) and create a highly energy efficient building that could operate independently of the normal electrical grid.

9. Shot Tower Melbourne Central Shopping Centre

Coop's Shot Tower and Flanking Building were erected in 1889-90 and consist of a two storey, three bay brick structure dominated by a fifty metre high castellated tower. The Tower was used for the manufacture of lead shot until closing in 1960. It remained unoccupied until being incorporated into the Melbourne Central shopping centre in the late 1980s-early 1990s.

Shot was manufactured by hoisting molten lead to the top of the tower, pouring it through a steel mesh to create droplets of lead that took up spherical form, cooled and solidified as they fell, to be finally quenched in a water bath in the base of the tower.

The tower is now protected by a massive modern steel and glass dome built as a feature of the Melbourne Central Development in 1986-91.

In 1901, the Melbourne Hydraulic Power Company (see also 7 above) established a second steam pumping station on the west side of the W Coop premises in order to improve the hydraulic service pressure in the surrounding area.



10. State Library Dome

The dome of the Reading Room of the State Library of Victoria was the first large ribbed reinforced concrete dome constructed in Australia. At the time of its completion in 1911 it was the largest dome of this type in the world at 35.1 metres diameter.

The domed reading room and surrounding book storage areas formed a significant expansion of the Library on which construction had commenced in 1854. The complex developed as the principal educational and cultural centre for Victoria, at one time housing the National Gallery of Victoria, the Industrial and Technological Museum and its successor, the Museum of Victoria as well as the Library.

The architect for the project was N G Peebles of Bates Smart. The original structural design was carried out by John (later General Sir John) Monash in 1906 using the Monier Reinforcing System. A modified structural design was carried out in 1909-10 by the Trussed Concrete Steel Company of London using the Kahn Trussed Bar reinforcement system. The dome was built by Swanson Brothers.

The skylights developed leaks, and the whole dome was encased in copper cladding for several decades, before a major refurbishment 1990-2005 again revealed the dome in all its glory.



11. Manchester Unity Building

The site, at 220 Collins Street was purchased by the Manchester Unity of Odd Fellows in 1928. Architect Marcus Barlow designed the building, which was built by W E Cooper Pty Ltd, contracted for the price of £215,000. Construction commenced on 1 January 1932 and proceeded around the clock in eight-hour shifts.

For the first time in Australia a construction progress schedule was used to track and manage the construction of the building. Progress payments to the builder were based on this schedule.

Such was the speed of construction that in May the basement and ground floor arcade were structurally complete and ready to be fitted out, and by the end of July the roof had been laid, floors having been added at the rate of one a week on average. The shopping areas were opened on 1 September 1932.

The building is of concrete-encased steel construction, with the exterior cladding consisting of terracotta faience tiles. Australian marbles are used extensively on interior walls. Two escalators, the first in Melbourne, were installed to provide access to the basement arcade and first floor from the ground floor arcade. Three high-speed elevators were installed, capable of a speed of 600 feet/minute (3.0m/s).



Image: National Trust of Australia (Victoria)

12. Gas Street Lighting near 230 Collins Street

The gas lighting standard on the kerbside in front of number 230 Collins Street is Melbourne's only remaining operational gas street light and reminder of how the CBD streets were lit in the second half of the 19th century.

Melbourne had gas street lighting from 1857. Gas was supplied from the Melbourne Gas & Coke Company's coal gas works in West Melbourne. In 1888 the latter company amalgamated with two subsequent competitors to become the Metropolitan Gas Co.

Street lighting in the CBD was the responsibility of the City Council and right from the outset there was dissatisfaction with the gas company charges and performance. In 1882 the nascent Australian Electric Company successfully trialed electric arc lighting in parts of Bourke and Swanston Streets, followed by other companies. This led the MCC to set up its own power station and replace all the CBD gas lights with electric lighting by 1895. (See also Spencer Street Power Station elsewhere in this brochure).

The original gas street lights had 'flat' or 'fishtail' jet type burners. The more efficient incandescent mantle burners fitted to this gas lantern became available by the mid 1890's. Gas lanterns with their burners replaced by electric lamps are evident in other places in the city.



Image: Miles Pierce

13. 333 Collins Street

The design of the octagonal, domed banking chamber, some 30 m high and 20 m across, was the result of a competition run by the Commercial Bank of Australia in 1892. The competition winners were Lloyd Tayler, and Alfred Dunn, who's banking chamber design was probably influenced by Guarino's Church of Lorenzo in Turin and the Great Mosque of Cordoba.

Construction was carried out by James Moore of South Melbourne and completed in less than a year.

In August of 1987, Nelsen Architects International were retained to design a major development on the site incorporating the earlier building.

This work was completed in 1990. The sandstone was shipped in from Gosford, NSW, the exterior lamps (that are miniature models of the building) were hand-made in solid brass.

Nelsen's revolutionary answer to preserving the great dome was to support a tower weighing some 10,000 tonnes over it on giant three-storey steel trusses which in turn rest on four piers, 3 m in diameter, going down 45 m into the ground. The engineers were Bonacci Winwood.



Image: source unknown

14. Melbourne Electric Tram System and W class trams

Melbourne enjoyed a cable tram network serving the central business district and inner suburban area starting in the boom period of the 1880's. (The system worked by a tram connecting on to a continuously moving cable beneath the road – just like in San Francisco). It developed to become one of the largest cable tram networks in the world.

By the early twentieth century, electric trams were seen as the way forward, including for servicing the developing further-out suburbs of the metropolis. In 1919 the newly formed Melbourne & Metropolitan Tramways Board (MMTB) took over operation of the tramways and progressively converted the cable tram routes to electric traction and extended the coverage of the network. The last cable tram ran in 1940.

The familiar electric tramcars plying the CBD street and suburban roadways have evolved over the years. The most well known of the early designs was the W Class, first made in the 1920s with many seeing around 60 years of service. A fleet of restored W Class trams now operates the free City Circle service and the service in Chapel and Church Streets. The tramways are now operated by Yarra Trams. Modern rolling stock has been progressively introduced in recent years along with a number of line extensions. It is now one of the world's largest urban tramway systems.



Image: Wikipedia - W-class Melbourne Trams



Image: Melbourne Metropolitan Tramways Board

Other Interesting Sites not on today's tour

ICI House (now Orica House)

Whether we love or hate the glass curtain-wall skyscrapers of the late twentieth century this one is special because in Australia it is where the skyscraper started. ICI House is a 20-storey office building in East Melbourne, the tallest building in Australia upon completion in 1958. This style of building changed the character of the central business districts of Australian cities forever and became a symbol of progress, modernity, efficiency and corporate power in post-war Melbourne. Furthermore it was constructed at the time when Melbourne was hosting the 1956 Olympic Games and was on show as one of the great cities of the world.

The building was designed by Sir Osborne McCutcheon of Bates Smart McCutcheon and followed the design trends of such famous buildings as the United Nations Headquarters Building in New York. It is an open-plan building with a concrete-clad steel frame and precast concrete floors.

The building made headlines for many years after initial construction as panes of glass occasionally fell to the street below.

It is one of the few post-war office buildings on the Victorian Heritage Register.



Image: Wikipedia - ICI House

Southern Cross Railway Station

Previously known as Spencer Street Station, this station originally served rail lines to various destinations in the State. The current building, with its distinctive curved roof, was built under a controversial Public-Private-Partnership and finished in 2009

The suburban rail network was expanded in the late 1970s by the construction of the partially underground rail loop that linked (then) Spencer Street Station and Flinders Street Station to the new stations of Flagstaff, Melbourne Central, and Parliament.



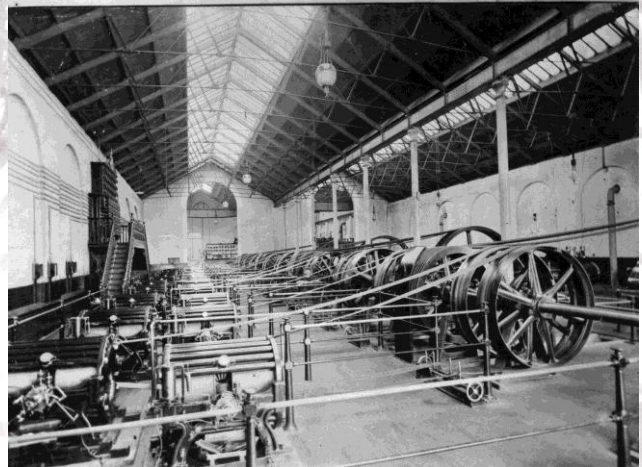
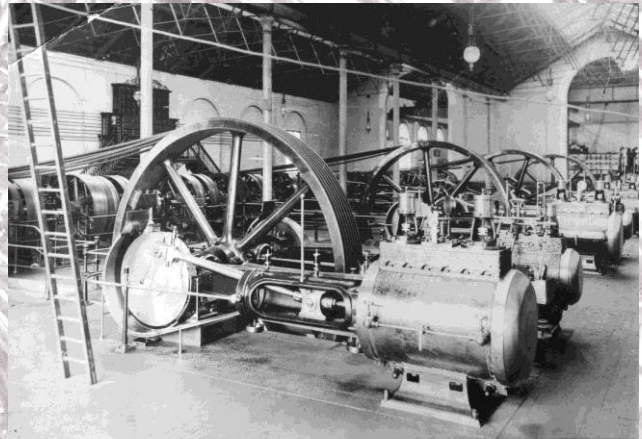
Image: e-architecture

Spencer Street Power Station

In 1891 the City of Melbourne resolved to establish its own power station for electric lighting in the CBD streets. Its Spencer Street power station was commissioned in 1894 with the first of four locally built Austral Otis slow-speed steam engines driving 3kV arc lighting dynamos. The plant was progressively expanded and by the mid 1890s all of the former gas lights in the CBD main streets had been replaced by electric arc lights. The power station subsequently supplied 2kV AC for street and domestic lighting in nearby MCC suburbs. In 1901 the arc lighting plant was replaced with direct-current generators to supply low-voltage DC to the CBD for both commercial premises lighting and motive power purposes.

During the early 20th century, the DC generating plant was in turn superseded by turbo-alternator sets with the CBD DC supply then maintained by rotary converter substations. The Spencer Street Power Station expanded until it was shut down in 1981.

The brick façade to Spencer Street and the building section immediately behind it are all that remains of the original engine room. A portion of the c1901 boilerhouse also remains on the south side. Some components are currently being incorporated into a total site redevelopment.



Steam engines (above) and line shafting and dynamos (below) in the power station c1894.

Image: Tom Ingram Collection

Victoria Dock (now Docklands redevelopment)

Following pressure from several Boards of Inquiry, the Melbourne Harbor Trust was finally established in 1877 tasked with improving access for shipping to Melbourne.

The Trust employed the British engineer Sir John Coode to suggest how best to upgrade all aspects of the port. His recommendations changed the shape of the lower Yarra River by creating the Coode Canal which was completed in 1886.

Coode also recommended that the land southwest of the city be used for another major dock facility which became Victoria Dock, opened in 1893. By 1908 it was handling ninety per cent of Victoria's imports. In 1914 its capacity was enlarged by the addition of a central pier and in 1925 the entrance was widened.

During World War II, Melbourne's role as the chief supply point for US forces meant that port workload increased.



Image: Museum Victoria

The post-war period saw the further development of the dock area and a progressive march downstream with the building of Appleton Dock, Webb Dock and Swanson Dock. These are now the core of the busiest container port in Australia.

Containerisation brought the usefulness of Victoria Dock to an end and the building of the Bolte Bridge cut off shipping access. The surrounding land was converted to mixed redevelopment and is now known as Docklands.

Spencer Street Bridge

The Spencer Street Bridge built by the Victorian Railways Construction Branch in 1929-30 is significant as a major new crossing of the Yarra River reflecting engineering and design standards intended to enhance the Yarra River as an aesthetic and recreational adjunct to the City of Melbourne.

The bridge is of technical significance as the earliest known variable depth steel plate girder bridge in Victoria and one of the earliest examples of composite road bridge design in which plate girders were "keyed" to a cast in-situ reinforced concrete deck by shear connectors to form an integral structure with enhanced stiffness. While this was not part of structural design for increasing bearing capacity of the bridge it predicts design trends that later became standard.



Image: Wikipedia - Spencer Street Bridge



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