Dunedin's Engineering Heritage Trail

Recognising the vision, skills and tenacity of early Engineers that were pivotal in the city's development and early prosperity.

Walk 1 – The Octagon Route

2.5km—1.5Hrs

Josephine in Otago Settlers Museum

Introduction

When telling the stories behind buildings, structures and machinery, there are a number of different slants that a researcher can take. Often, the emphasis is on the architecture, the science or the social history. This brochure reflects the stories from an Engineering perspective. However, like so much in life, the subject matter doesn't fall neatly into categories and for some sites we need to consider the role of other professions aside from our own. But with the theme being Engineering, we won't dwell on cosmetic details or personalities, instead recognising the significant skills, concepts, technologies and visions associated with each point of interest.

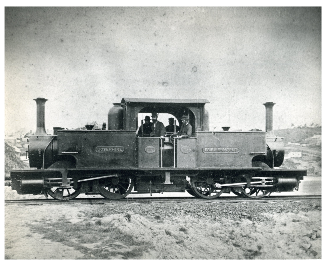
The term Engineering has much wider scope than most people realise, including Structural, Fire, Civil, Hydraulic, Electrical, Mechanical, Telecommunications and Transport. Therefore, the IPENZ Heritage Chapter has prepared these walks to give a sample of the city's rich past while demonstrating as many different disciplines as possible.

The official European settlement of Dunedin started in 1848 when Scottish Presbyterians arrived. The Gabriels Gully gold rush of 1861 brought thousands of miners and much money to Otago. Dunedin became the largest city in NZ and there was an increasing demand for engineering services.

1 Otago Settlers Museum

The oldest building on this site was opened in 1907 as an Art Gallery. The adjoining Settlers Hall opened 1908. They were designed by Architect Arthur John Burnside and built by Mr Orr Campbell. The Donald Reid wing was built by Loan and Watson and opened in 1922. Josephine was moved into this wing in the 1960s.

2 Josephine and Locomotive J^{A}1274



Josephine and long lost sister Rose were the first 3' 6" gauge locomotives in New Zealand, while J^A 1274 was the last steam locomotive to be built in New Zealand. Josephine was shipped to Port Chalmers in 1872 and was used mainly on the Dunedin to Port Chalmers line but later on the South Island Main Trunk line, and at Wanganui and various lines in Otago.

In 1917, at the end of its working life, Josephine was sold as scrap to the Otago Iron Rolling Mills for £173. The Rolling Mill owners were reluctant to melt it down and used it to provide steam when one of their boilers failed. The mill owners presented Josephine to the Otago Early Settlers Museum in 1924 and it was displayed at the New Zealand and South Seas International Exhibition in Dunedin in 1925. Left sitting outside the museum, it again faced the scrap heap in the late 1960s. A successful campaign for Josephine's restoration ensured that it was made presentable and placed within the museum building.

J^A 1274 was built by New Zealand Railways at Hillside Railway Workshops in Dunedin to a design similar to that used by the North British locomotive works. It was the last of a batch of 35 locomotives and was completed in December 1956, retiring in May 1971 after travelling nearly 444,000 miles. It was withdrawn due to a recurring boiler problem, but other class members operated until the withdrawal of steam in October 1971.

3 South Island Main Trunk Railway

The South Island Main Trunk Line evolved through a number of decades rather than being built as a complete railway and ceremoniously opened. The line promoted by the Dunedin and Port Chalmers Railway Company opened in 1873, and was the first line to adopt the 3' 6" gauge that became the New Zealand standard. Between Andersons Bay Road and the Caversham Tunnel, the line was elevated on a timber trestle that was then backfilled to form the embankments seen today.

The causeway construction and double-tracking between Dunedin and Sawyers Bay took place in a number of stages between 1908 and 1948. The line north from Dunedin had much of its second track removed in 1984 and the Mosgiel line was converted to a single track in the early 1990's. The Centralised Train Control signalling system was also replaced by the Track Warrant system at that time.

The Main Trunk continues to be a major transport artery. The route north is steep and winding, and has severe speed restrictions in places. Early trains were hauled by tank engines (including Josephine), but by 1895 more powerful tender engines were in use. Locomotives were constructed in the UK, then the USA, as well as the Hillside Workshops here in Dunedin and other Government Railway workshops. Diesel locomotives came into use from 1957.

4 Dunedin Railway Station

The Dunedin Railway Station foundation stone was laid in 1904 and the building officially opened in 1906 to cater for the travelling public of what was then New Zealand's commercial centre.

It was designed by George A Troup, the first official architect of the New Zealand Railways, who designed many other stations in New Zealand, including New Plymouth, Lower Hutt and Bluff.

The construction of the Dunedin Railway Station was an outstanding engineering feat for its time. It was built on land reclaimed from the harbour, and numerous difficulties were faced by contractors. 600 Australian hardwood piles were driven into the reclaimed land and remain below the high tide mark. On these was laid a plinth of stone and concrete, mixed by the first electrically operated concrete mixer to be used in Dunedin. Two steam cranes were used to lift stones into position and platforms for the cranes had to be built as the building grew in height.

The original main foyer floor consisted of 725,760 half-inch porcelain squares manufactured by Royal Doulton in England especially for the New Zealand Railways. In the 1960s the floor was replaced by a replica of the original following subsidence.

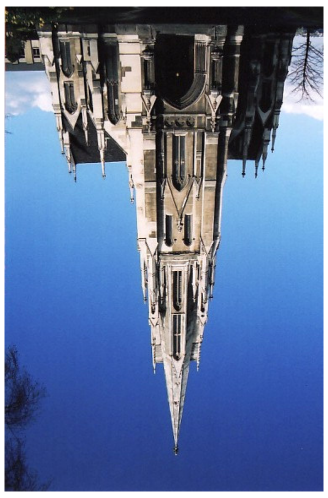
17 Dowling Street Steps

This was part of Bell Hill. Initially there were wooden steps here. This fortress-like structure was erected in 1926 when Dowling Street was widened. It has steps and a ramp and is also a massive retaining wall. The steps are enclosed in a citadel-like structure that takes on the appearance of the local basalt.

18 First Church

A Church Reserve was established here by the first settlers in 1848 but construction of the current building wasn't commenced until 1867 as the site was lowered to provide fill for reclamation work. The design competition for a church was won by Robert Arthur Lawson and construction was undertaken by D & J Hunter, Builders.

The spire is 53 m high. When originally built, the top portion of the spire was slightly out of perpendicular and 4.6 m too short so had to be rebuilt. The church opened in 1873 and has seating for 1,000 people.



The exterior walls of the church are of brick, lined with Oamaru stone, making a solid wall about 500mm thick. The tower and spire were similarly constructed, the spire being hollow for about two thirds of its height, with the remainder solid. The tower was strengthened with galvanised tie rods in 1964/65 and these were replaced with stainless steel rods in 1990. J R G Hanlon was the Structural Engineer for the strengthening and W H Naylor was the contractor.

Otago Settlers Museum displays

The walk ends at First Church but you can return to the Settlers Museum and look at some of the displays there. As well as Josephine and the J^A locomotive, there is a cable car, coach, bullock wagon, cars and bicycles, along with computers and historical records.

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This brochure has been produced by The Institution of Professional Engineers (IPENZ) Engineering Heritage Otago Chapter with assistance from Otago Settlers Museum and DCC Community & Recreation Services.
Recognising achievements in engineering, industry and technology in Otago & Southland.
www.ipenz.org.nz/heritage

5 Dunedin Law Courts

This building was designed in the engineers' section of the NZ Public Works Department and built between 1900 & 1902 by Archibald Shaw. The contract price was £19,311 The Engineer in Chief was William Hales; Architect John Campbell. It was restored between 2000 and 2002 to allow it to fulfil the role of a modern Court while retaining its ambience and heritage value. The structural strengthening work was designed in Dunedin by Lou Robinson of Hadley & Robinson. For this work, Lou Robinson was awarded the David Cox Memorial Award (2003) which recognises & encourages excellence in the restoration, conservation and continued use of historic buildings & structures in Otago.

6 Former Shoreline

Dunbar Street (once called Jail Street) used to be the shoreline at the foot of Bell Hill. Land west of Dunbar Street was excavated in the 1860s. Land east of here has been reclaimed.

7 Cumberland St /Stuart St Traffic Signals

Traffic hazards became evident early last century. The City Council passed a bylaw in 1908 imposing a speed limit of four miles per hour for mechanically propelled vehicles rounding corners. Cumberland Street is the Main Highway through Dunedin and this was a very busy intersection. In the 1920s, the Police provided a pointsman for four hours per day. In 1929 the City Council ordered a mechanical control apparatus (traffic signals) and these commenced operation on 10 July 1930.

There were many complaints from the public. Drivers turned right and saw red lights so stopped in the middle of the intersection. Council's first traffic engineering decision was to ban right turns. The signals were cam operated and on a fixed cycle. The lights flashed and there was an amber light both before and after the red light. This was the second set of signals in NZ (Wellington had the first set).

8 Buildings on reclaimed harbour mud

If you look north along Cumberland St, from the Lower Stuart St corner, you'll see the Evening Star building (designed by Edmund Anscombe in about 1930) where the Otago Daily Times is now produced. Beyond, Cadbury Confectionery's complex covers the rest of the block. The whole of this Cumberland St. area was once a tidal mud-flat, and the ground has little load-bearing capacity, necessitating special foundations for the larger buildings. Some of the later and higher Cadbury buildings and silos rest on quite deep raft foundations, while the new Police Headquarters is supported on driven piles. A recent engineering feat in the area (1997) was the installation of a 310 tonne printing press in the Otago Daily Times building. It had to be located at first floor level and had to resist vibrations while the press prints the newspapers. It is supported on 28 piles driven up to 17 metres into reclaimed land and harbour silts, then into a boulder layer. The piles are linked with reinforced concrete and the press is placed on prestressed Tee beams sitting on the pile caps. Several cranes were required to move the press into the final position.

9 Public Transport - The Octagon

The Octagon has been a key node in the City's public transport routes for over a hundred and twenty years.
From 1879, steam and horse trams ran along Princes and George Streets.

From 1900 cable cars ran up Stuart Street to Highgate and down to Nairn Street in Kaikorai Valley. They stopped running in 1947. From 1903 electric trams ran along Princes and George Streets, from 1930s diesel buses and from 1952 trolley buses.

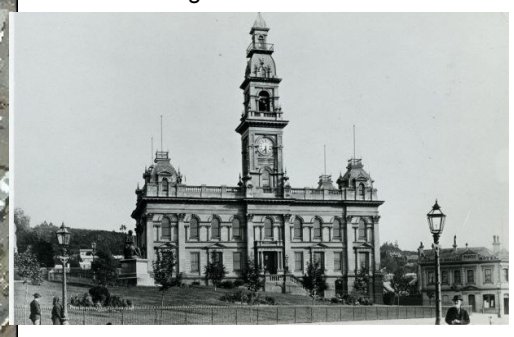
Diesel buses took over the trolley bus routes incrementally throughout the 1970's. During this period, routes were modified so that they all started or ended close to the Octagon.

10 Municipal Chambers

From the time the Dunedin Town Board was established in 1855, the location of their offices was a matter of some debate and they moved from one place to another depending on what was available. Following the gold rushes, there was increasing pressure for the body to have a home which better reflected its status and importance to the community. After a competition in 1877, the winning design was chosen but was not that ultimately built. The competitor placed second, R A Lawson, had been appointed architect since he was resident in Dunedin. He was no doubt reluctant to work on another man's design so he was eventually permitted to use his own. The Municipal Chambers, built of Oamaru limestone on a base level of Port Chalmers breccia is of three storeys high with a 47 metre high tower.

In 1963, a report from the City Engineer, G K Armstrong advised that the clock tower beyond the balustrade immediately above the clock was unsafe and the tower was subsequently demolished above this balustrade level and capped.

Consideration was given to demolishing the whole building after completion of the neighbouring Civic Centre, due to rising maintenance costs. Fortunately, in 1989, the building and adjoining Town Hall complex were instead refurbished. This work included earthquake strengthening, reinstatement of the clock-tower to its former profile and height, and reinstatement of the steps from the Octagon level. The use of light weight concrete and pre-formed sections saw the tower re-built to withstand current design loadings while at the same time looking the same as the original tower.



11 St Paul's Cathedral

When the present St. Pauls Cathedral was built in 1915-1919, there was an intention to build a Sanctuary at the north-east end but it wasn't completed at that time. The cathedral was designed by English Architects Sedding and Wheatley and construction was supervised by Dunedin Architect Basil Hooper. The drawings were beautifully detailed, even to the extent of each stone of the vaulted ceiling being individually numbered. These stones are fixed to a massive concrete diaphragm at ceiling level, vaulted and suspended across the nave below on stone columns. In the 1960s the Church hierarchy decided to complete the Sanctuary and engaged McCoy and Wixon for the project. Dave McLaren was the Structural Engineer for the Sanctuary. The new sanctuary is seismically stable and independent of the rest of the building. The Sanctuary floor is of precast prestressed double tee beams giving an unobstructed view across the crypt area below.

12 King Edward Technical College

Dunedin Technical College was a secondary school and night school providing engineering education and it was the first school of its kind in New Zealand. The main building is of brick and Oamaru stone, built by William McLellan in 1913. Burt Hall was built in 1918.

13 Dominican Priory

This was the largest building in the southern hemisphere built of unreinforced poured concrete. It was designed by F. W. Petre, nicknamed "Lord Concrete" and built in 1877. This is a remarkable multi-storey building for its time. The concrete walls at ground level are immensely massive for this material, being 610mm thick. The avoidance of curved (Gothic-arch) windows was probably to simplify the formwork, as a four-storeyed building in concrete would test the ability of most contractors at that time. It has a Category 1 Historic Places Trust listing.

14 Otago Girls High School

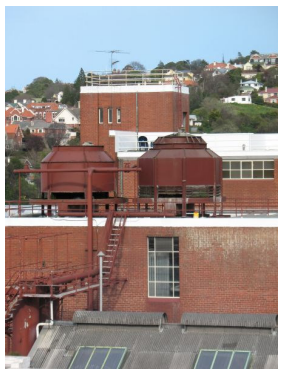
Otago Girls High School is the oldest girls' high school in the southern hemisphere and said to be the sixth oldest in the world. It was founded in 1871. The main building was opened 1910. The Architect was Edmund Anscombe who based the design on Hampton Court Palace. It was built by Mr Orr Campbell who built the Otago Settlers Museum building. Anscombe also designed most of the older University buildings. Because this building was of unreinforced masonry with wooden floors, earthquake compliance became a major issue. It was decided in the late 1980's to retain the facade but completely gut the structure and to virtually build a new building within the existing building.

The technique used was the American development of "shotcreting". The exterior walls and the masonry crosswalls were pin-cushioned with reinforcing rods epoxied into the brickwork, faced with a web of reinforcing and covered with 100-120 mm concrete fired onto the wall with a pressure gun.

15 Tennyson Street Electricity Substation

This electricity distribution substation built c1948 consists of a ground mounted transformer with ring main fuse switchgear on the high tension side. Both the high tension (6.6 kilovolts) and the low tension (400 volt) is transmitted by underground cables. The substation provides both 400 volt 3 phase and 230 volt single phase into the surrounding area.

16 View from Tennyson Street



From this vantage point, we can see examples of a diverse array of engineering disciplines. Roughly from right to left, we can see Canongate - the interrupted street, with sections of carriageway and steps. Of note are the retaining walls, there are a large number of these in Dunedin. Far away, towards St Clair, just to the right of NZ Army hall, you can see the power transmission towers that carry the main cables from the national grid to the southern substation. Speights Brewery,

one of the few surviving gravity breweries in the world, has a maze of pipework services, lift towers, machine rooms & cooling evaporators as well as the iconic chimney.

The Telecom building has a host of antennae and dishes to link the city with the outside world. This building was developed to facilitate Standard Trunk Dialing. The project was designed in the Post Office District Engineer's Office in Dunedin. The building architectural design was by R N (Bob) Everest of MWD, Dunedin and was opened by NZPO District Engineer Bill Elliott on 30 Nov 1979.