



02 The NZASM and its Built Legacy

Historical and Chronological Background

A short history of the NZASM

The *Volksraad* of the *Zuid-Afrikaansche Republiek* (ZAR, Transvaal Republic: 1854-1902), desired that a rail connection to the coast, through Portuguese East Africa (Mozambique) to the harbour in Delagoa Bay (Lorenço Marques, now Maputo), be developed. The *Volksraad* had already in 1874 nominated a commission to study the laying of a rail connection with Delagoa Bay but this project was hampered by a shortage of capital and the then scuppered by British annexation of the ZAR in 1879. Independence was restored to the ZAR in 1881.

In 1886 gold was discovered on the Witwatersrand which both promised revenue for the country but increased political pressures both for the development of infrastructure to service the mines as well as more efficient transport connections to the coast, particularly the harbours of the Cape and Natal Colonies through the territory of the Orange Free State Republic, to the railway systems of the Cape Colony and Natal Colony. The *Nederlandsche Zuid-Afrikaansche Spoorweg-Maatschappij* (NZASM) was floated as a company for the construction and operation of the railway network of the ZAR on 31 June 1887. The chief engineer, RAI Snethlage, and his colleagues started their surveying at Komatipoort in 1887. Malaria, tariff disputes between the Republic and Portugal,

and the complexities of finding a suitable line up the Crocodile River Poort and from the Lowveld to the Highveld up the escarpment delayed construction. Consequently the NZASM first began laying a railway between Johannesburg and Boksburg (the so-called 'Rand Tram'), which was opened in 1890 and later extended to Springs and Krugersdorp. The completion of a railway bridge over the Vaal River in 1892 made possible the connection to the Cape Colony by way of the Orange Free State Republic through the completion of the Southern Line. The Eastern Line to the Mozambican border was complete by 1894 and the South Eastern Line to the Natal border just beyond Volksrust in 1896, thereby establishing three rail entries into the ZAR.

Railway conferences, in which the NZASM also took part, were held in Pietermaritzburg and Cape Town in 1897 and 1898 between the Transvaal and Orange Free State Republics and the British Cape- and Natal Colonies. In April 1899 the successor to the Chief Engineer Middelberg, who had left at the end of 1898, Jhr JA van Kretschmar van Veen, had under his control a staff of 1770 Netherlanders and ex-Netherlanders, 4477 South Africans of which 3700 were black and 777 white labour and 1615 representatives of 26 other nationalities. The operation of the NZASM railway system was a truly international endeavour.

02.01 (Left): NZASM C-Type house in Cowen Ntuli Street, Middelburg, Mpumalanga, showing various alterations and additions but with the original still clearly identifiable.

02.02 (Right): Barberton Station in the 1901. This was the terminus of the Barberton Branch Line. This station has since been demolished. (E.W. Byerley (Nico Moolman collection) [Public domain], via Wikimedia Commons)



On 1899 09 13 the Executive Council of the ZAR put the railway lines, the staff and the rolling stock of the NZASM at the disposal of the Commandant-General. After the British occupation of Pretoria the NZASM archives were taken over by the Imperial Military Railways (IMR) on 1900 08 03. All NZASM properties were confiscated on 1900 09 12, after 1400 members of staff and their families had been deported and repatriated to Europe by the British authorities. The last serving staff of the NZASM left Komatipoort on 1900 09 18, soon followed by Van Kretschmar van Veen. The Portuguese government delivered NZASM rolling stock in Lourenço Marques to Britain and on 1901 01 10 the company ceased its payments. In 1908 an arrangement was made between the British government and the NZASM by which the company would receive more than £300 000 in compensation and the British government undertook to destroy all shares, which were in the possession of Crown agents for the colonies. The NZASM was dissolved on 1908 10 13.

The NZASM built and ran the following during its period of activity in South Africa,

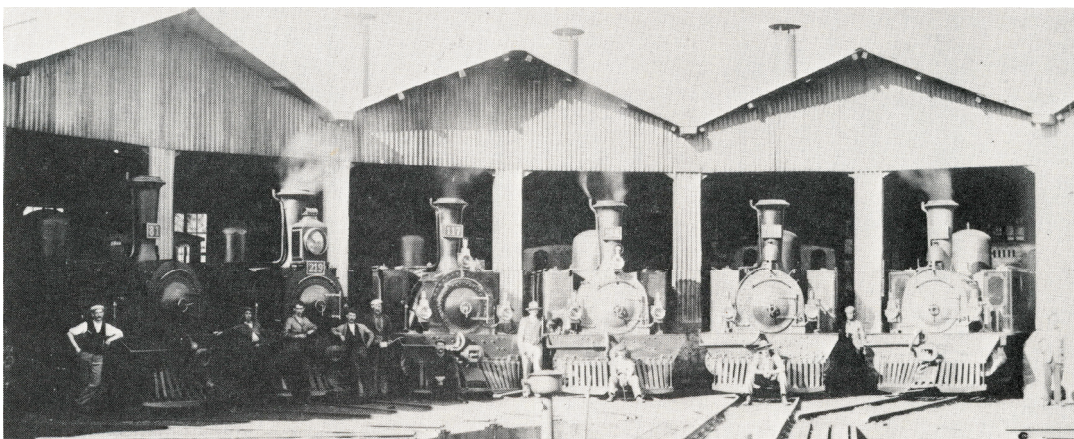
- Rand Tram (1890-1899)
- Southern Line (1890-1899)
- Eastern Line (1889-1899)

- Barberton Branch Line (1892-1899)
- South-Eastern Line (1894-1899)
- South-Western Line (1895-1899)

The ZAR and other rail development

The NZASM was not the only entity to develop rail infrastructure in the territory of the former ZAR during its existence. A concession was granted to the Pretoria-Pietersburg Railway Company to develop rail connections with the north of the ZAR, as was one to the Ermelo Railways Company. The ZAR itself developed its own lines, after appointment of the NZASM engineer ME De Wildt as its Technical Inspector, Advisor and Chief Engineer, within its own Department of Railways. Under his instruction the ZAR itself developed Vryheid-De Jagersdrift railway (today located in Kwa Zulu-Natal). The infrastructure of the latter is all but indistinguishable from that built by the NZASM. De Wildt acted as advisor to the Pretoria-Pietersburg Railway Line as well.

The concession for the construction and operation of the Selati Line, connecting Komatipoort with Selati gold fields, was granted to the Selati Company in 1890. This concession was to be plagued by mismanagement, corruption and nepotism. After



02.03 (top): The former Platrand Station on the South-Eastern Line (NZASM_SEL_038). This station lost its function when the railway line was rerouted. It has subsequently served as housing for the greater part of its history.

02.04 (bottom): The locomotive-shed (or roundhouse) at Waterval Boven: a NZASM typology of which no example has remained. (De Jong et al: 1988)

the Anglo-Boer War, Lord Milner continued a pre-war probe into the Selati matter and the late ZAR administration, under whose averted gaze the Selati Line fiasco had unfolded, was publicly humiliated.

EXPERTISE

Emigrant Professions

- Some noteworthy Architects

Burg, JR (1874–1960)
 De Zwaan, WJ (1867–1948)
 Geers, LM (1877–1957)
 Gradon, HT (1855–1917)
 Hoogterp, [?] (fl 1888)
 Kesting, JJ (1870–1929)
 Klinkhamer, JF (1854–1928)
 Van Lissa, VAHC (1863–1947)

- Some Noteworthy Engineers

Breuning, MEH (fl 1893)
 Bouten, PH (1857–1952)
 Cluysenaer, JL (1843–1932)
 De Wildt, ME (1855–1907)
 Groll, C (fl 1887)
 Kist, NC (1867–1941)
 Loudon, H. (1860–1941)
 Middelberg, C (1846–1916)
 Mooyen, W. (fl 1887)
 Sissingh (fl 1887)
 Snethlage, RAI (1845–1919)
 Steinmetz WL (fl 1887)
 Van der Made, C (1858–1902)
 Van der Meulen, GH (1864–1888)
 Van Eelde, AGA (fl 1887)
 Van Ijsendijk, JE (1858–1888)
 Van Kretschmar van Veen, GA (1857–1931)
 Van Lennep, A (1862–1934)
 Verweij, W (??)
 Westenbergh, A (1858–1902)

Indigenous Labour

The 3700 black South Africans employed NZASM in 1897 were full-time employees of its operations and not for the construction of the lines. The NZASM outsourced its construction to private contractors, who often employed subcontractors. The contractors and subcontractors relied heavily on the oppressive labour practices then current in the larger southern African region, also legislated in the ZAR. As instance, it is reported that at the start of the construction of the Eastern Line section through the Crocodile Poort, the ZAR government was requested to provide labourers for the employment by the contractors and subcontractors, and the so-called *Naturellekommissaris* 'provided' 3000 men. Very little is known about the labour conditions of these press-ganged men, except that the NZASM did intercede when contractors or subcontractors failed to pay them their wages.

EXTANT INDIVIDUAL STRUCTURAL TYPES

For the construction of its buildings and other structures the NZASM engineers preferred natural stone such as sandstone, ironstone (dolerite) or hornstone ('blouklip'). These building materials were readily available at many places along the rail trajectories and obtainable free of charge. They possessed great strength and beauty and were well suited for use in the designs chosen. For these reasons most buildings of the Eastern and South-Eastern lines consist of sandstone or other natural stone.

Brick was used in places where natural building stone was unobtainable locally, or where brick was cheaper and more readily available, as was the case with most of the buildings of the South-Western (Klerksdorp) Line.

02.05: The NZASM Volksrust recreation hall (NZASM_SEL_003), which housed a kitchen for serving meals. The building, now abandoned, contains much valuable and original fabric and has high potential for re-use.



NZASM stone masonry and brickwork were generally of a high quality because of the strict regulations specifying the laying of foundations, the shapes and sizes of stone blocks and bricks, the manner in which courses were to be laid, the width and finish of mortar bonds and the composition of mortar.

The erection of many of the NZASM buildings was the largest single exercise in lightweight construction using industrially manufactured materials such as corrugated sheet metal, after those of the goldmines on the Witwatersrand, at that time.

On the Rand Tram and the Southern Line many buildings of corrugated iron were also constructed by the NZASM, especially station buildings. On the Rand Tram this blended well with the corrugated iron settlements of the goldmines in its proximity. Corrugated iron was used throughout on all the lines for the plain industrial structures such as sheds, locomotive roundhouses (of which none remain) and workshops.

Most of the ironwork of buildings, and nearly all requirements for floorboards, frames, ceilings, doors, window sashes and panes, fixtures, paint, cement and roof timbers were imported from the Netherlands, Belgium and Germany.

Housing

The houses for NZASM employees were designed by type, each according to the status of the employee. These were invariably white and mainly Dutch immigrants. Types were distinguished by alphabetical codes. Hence Type A houses were twelve room dormitory roomed lodgings for single

employees. Type A1 was similar but had only eight rooms. Type B and B1 and the somewhat larger Type C and C1 were either stand alone or, more typically, semi-detached cottages for married workers having higher ranking. Employees of status, such as doctors and managers had custom designed homesteads. The masonry was invariably locally sourced stone, later brick, with all timber, iron and fittings being imported. Variations in the designs reflected the locality, houses in the Lowveld having ventilated double roofs, an idea imported from the earlier Dutch railway venture in Indonesia. Initially much of the construction would have been of prefabricated wood and iron, but as development took place, more permanent dwellings were constructed to the exacting technical requirements and material specifications of the NZASM. Because of this many such structures are still extant and are occupied.

Halts and Stations

The Pretoria NZASM drawing office under direction of Van Lissa developed drawings of type structures for all construction.

These were most often based on the principle of incremental growth. Prefabrication became the norm for temporary wooden structures and bridges so as to control dimensional co-ordination, material quality and speed of erection. The development of standardised building types was influenced by location, specific functions, imported and locally available materials and technologies and the formal and the aesthetic influences inherited from either the Netherlands or that of already established local mining industry and railway architecture.



02.06 (left): The memorial plaque installed in the *Hervormde* (Reformed) Church in Pretoria commemorating the NZASM personnel who died in action in the Anglo-Boer War. (Nederlandsche Zuid-Afrikaanse Spoorwegmaatschappij; c.1909)

02.07 (right): Water tank stands at Bank on the South-Western Line, adapted over time. The corrugated iron pump house is also of NZASM construction.



- Railway stations

The NZASM that by 1890 had long past the NZASM railway stations were of two main types, derived from standard station design in the Netherlands, namely either island (Type I) or edge (Type II), the latter serving as a crossing station. The type required, size of town and resultant volume of traffic determined station size. Main stations had ancillary functions such as restaurants and station master's quarters.

- Halts

The simplest form of permanent station were halts such as that of Oorsprong on the Eastern Line. These structures were double pitched-roof buildings with continuous curved ridge roof sheeting and extensions to form front verandahs. The walls were constructed with 'floatstone' that was made of crushed pumice and chalk on timber frames. These materials as well as the steel window frames and doors and interior teak woodwork were imported from Europe. The fully-fledged station at Komatipoort depicts an extended version of the halt type with additional support buildings and can be seen as the foundation for the elongated station form used in Kaapmuiden that was later replaced by a permanent face brick building—a typical island station.

- Crossing stations (Type I)

Fully-fledged permanent stations were of two types – either island where railway lines crossed (Type I) or edge stations (Type II). Type 1 had two rooms, one housing the stationmaster and the other acting as a waiting room. Sometimes the Type 1 stations had separate restaurant and ablution buildings.

- Island Stations (Type II)

The most sophisticated of NZASM stations are Type II Island Stations, such as Kaapmuiden, where the separate buildings, are joined with one roof creating an undercover waiting area.

- Goods- and Workshop Sheds and Roundhouses

Larger crossing- and terminal stations were provided with goods sheds. These were of light-weight portal-frame construction—the structure often manufactured from railway track, cranked to purpose—covered in corrugated sheeting.

The NZASM established a large workshop precinct at Salvokop, Pretoria, which has been demolished. The same goes for the distinctive roundhouses constructed by the NZASM—also steel frame over which corrugated iron cladding—at main stations.

Community Buildings

The NZASM provided its employees with social and community buildings, such as recreation halls, (at for instance Johannesburg and Komatipoort) and schools (Volksrust and Pretoria). The Salvokop precinct in Pretoria was provided with a cycle track and skittles ally amongst others. These were for the use of white employees only.

Memorials, Monuments and Graves

Larger more important structures were often provided with foundation stone. These include the Heidelberg Station, the Komati River Bridge and the NZASM Eastern Line Operations Headquarters at Waterval Boven. Graves of white NZASM employees can be found throughout the geographic area of their operations including at Komatipoort and Pretoria.

The NZASM and its employees have been memorialised in a number of places. A memorial was erected at Waterval Boven in 1948 to commemorate those who gave their lives in the construction of the Eastern Line. Memorials to the NZASM personnel who died in service during the Anglo-Boer War exist in both Pretoria and Bloemfontein.

02.08: The first completed bridge on the Eastern Line with a masonry substructure and plate girder superstructure. The title of the original is *Tienmetersbrug, Kilom. 0,4. 1e brug in den Spoorweg* (Ten meter bridge, Km 0,4. 1st bridge in the railway). (Transnet Heritage Archives, Johannesburg)

ENGINEERED MASONRY STRUCTURES

While all structures erected by the NZASM along their lines were built in situ, they were in fact a 'kit of parts' of predetermined size and design, each appropriate to the circumstances. It must have been apparent that, although often dry in winter, when summer rains came to the highlands where most of the rail was located, flash flooding might easily inundate or damage rail infrastructure. Although precautions were taken, there was still severe damage by flooding along the Barberton Branch line during construction, even before the rail was commissioned, and the necessary steps were taken to heighten bridges during repairs.

Culverts

When one travels along the trajectories of the old NZASM lines one will often notice stone culverts, many still in place and thundered over by the freight and passenger trains that traverse these lines even today, although tracks have been raised, concrete added, heavier rail profiles laid and trajectories straightened. Where lines have been doubled, tripled or even quadrupled often the original stone masonry remains and subsumed into the larger requisite concrete structures.

Flat lintel culverts (box culverts) generally have small stone piers and are constructed with one, two or three drainage channels. Initially they were bridged with steel rail lintels encased in mass concrete. These structures occur with one, two or three spans the latter two separated by piers.

Arched culverts are constructed of rough ashlar with voussoirs and keystones. Often the blocks for the vaulting is of softer sandstone while the rest of the stone masonry is of harder local stone - granite, dolerite or modderklip (a hard metamorphosed secondary rock).

Retaining walls

The construction of the Eastern line up the Crocodile Poort and the Elands Valley required navigating rough terrain. Often cuttings had to be stabilized. These cuttings were lined with rough ashlar retaining walls, sometime reaching up to 4 metres in height, exhibiting the same high quality of craftsmanship as other NZASM structures.

Cuttings

The NZASM tried to avoid excessive cutting in its trajectory planning. Yet it is reported that on average 2000 sticks of dynamite were detonated per day during the construction of the Eastern Line through the Crocodile Poort. Other cuttings were undertaken, for instance where the South-Eastern Line crossed the Suikerboschrand River.

Wells

Provisioning the steam locomotives with water required an extensive water network. Dams were built, pipes laid on to fill water tanks. These were also filled from percolation wells. These round structures, built of rough ashlar, were located next to riverbeds, their floors dug down to the level of the water table, their walls extended to above flood lines. These wells ensured a reliable, clean water source, even during period of flooding. Pumps were mounted on top of the wells.

Embankments

Even though the NZASM followed the contours of the landscape as far as possible, the construction of earthen embankments was inevitable. The more profitable and busy a line was projected to be, the more cost could be spent on its construction and hence the higher the embankments constructed.

Masonry Water Tank Stands

Watering points were required, two parallel tapering rough ashlar walls were constructed to carry the large cast-iron water tanks.

Viaducts

These are often constructed of larger arched structures with one or more causeways, either equi-spanned or symmetrical smaller spans about a larger central vault.

Bridges

- Stone Arched Bridges

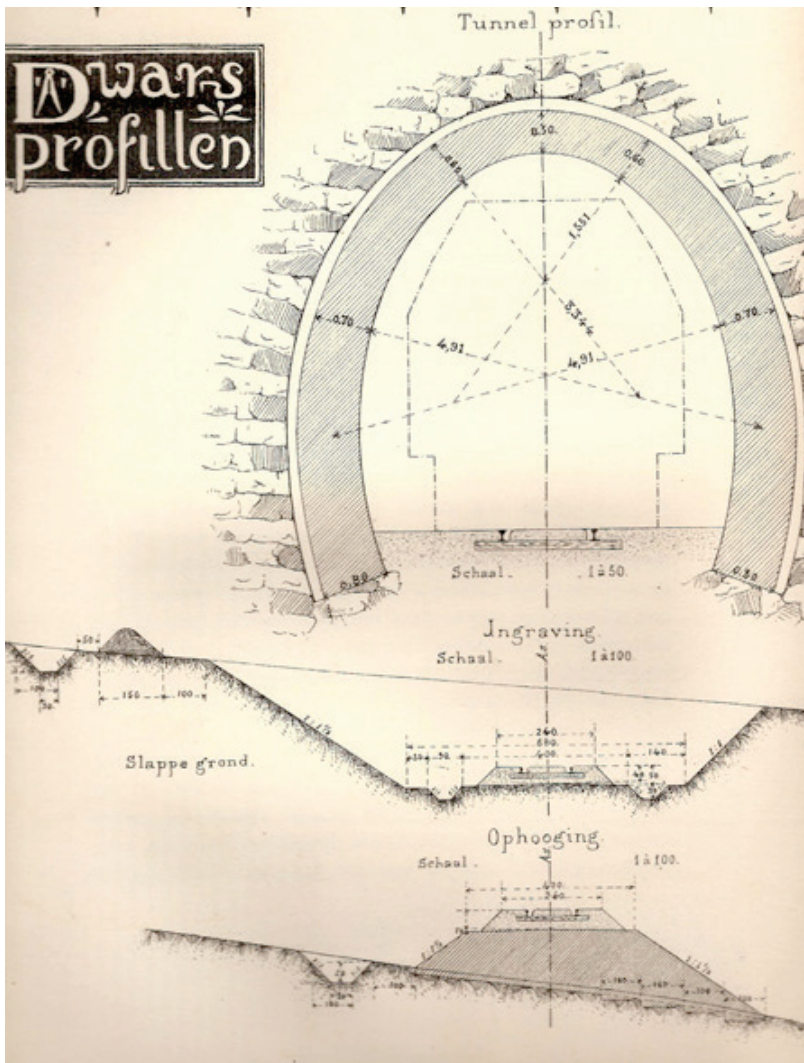
Only a single stone bridge serves as example, the fine Five Arched Bridge (Bridge over the Dwaalspruit), built in this fashion as it carried the ratchet line at an incline, so precluding the use of steel.

- Vaulted Stone Tunnel

Only one tunnel was constructed by the NZASM, that between Waterval Onder and Waterval Boven, constructed of a parabolic vaulted blue stone lining to a curved alignment to accommodate the incline and trajectory of the ratchet rail, a remarkable piece of engineering, now defunct.

ENGINEERED STEEL STRUCTURES

The Dutch came to the NZASM: Nederlandsche Zuid-Afrikaansche Spoorweg-Maatschappij endeavour in the ZAR [Zuid-Afrikaansche Republiek] with their experiences of railway construction both at home and in Indonesia. By this time empirical knowledge and understanding had been systematized into a kit-of-parts. Contracts could be awarded in both sections of lines as well as their various categories of construction – earthworks, stone-masonry, ballast and rail-line placement and engineered steel works.



02.09: A profile section of the NZASM tunnel at Waterval Boven, and typical cutting and embankment sections: a good illustration of NZASM engineering. (Nederlansche Zuid-Afrikaansche Spoorwegmaatschappij; c.1909)

All steel was imported from either the Netherlands and Germany in prefabricated sections to the design supplied by the NZASM engineers, inspected there then landed in one of the harbours – either Lorenzo Marques (Maputo), Durban or East London and brought in by ox-wagon, later on the railway wagons along newly completed lines.

All drawing were supplied in metric measure and supplied to metric tolerances. All bridge spans were designed in increments of five metres. Any variations in span widths were resolved in combinations of these span distances. While much of the NZASM steelwork no longer remains, all structures and tracks being re-laid for heavier rolling-stock and freight, much of the replaced steel followed the same design as the original NZASM, although with heavier steel sections.

Five metre spans (the shortest) were of flat plate girder steel, ten metre spans were also of plate girder.

Twenty metre spans were of plate fish-belly girders, twenty-five metre spans were bridged by-bow-string trusses. Thirty metre spans were of truss-girders, either upright or inverted. Finally there was

a longer thirty-five metre span, also of a girder truss design, for bridging a section of the Vaal River at Standerton.

Much of the steelwork was deliberately damaged by Dutch explosive engineers serving the Boer forces as they retreated in the Anglo-Boer War, the Imperial Military Railways (IMR) effecting repairs or replacement as these positions and infrastructure were captured, occupied and put to their own use.

After the War the railway infrastructure was eventually unified into a single and centrally managed railway system, and, in time, all steel was replaced, so that little by way of original NZASM steel is still in place or functional.

- Rail Lines

The rail lines of the NZASM consisted of gravel ballast on which timber sleepers—teak imported from Indonesia, then the Dutch Netherlands Indies colony—onto which the railway track was fixed with rail nails. The width was Cape Gauge. Rail track was imported from Germany, produced by the Bochum Steel Works in the town of the same name.

- Water Tanks and steel stands

Stations and their precincts were provided with tap water. For this steel tank stands were erected on which cast iron water tanks (manufactured by the *Machiene Fabriek Breda* the Netherlands) were positioned.

Conclusions

In order to conduct field research, it is necessary to know what types of structures to expect. If not sensitized, the researcher, when conducting fieldwork research, may miss or misidentify often altered or appropriated structures. It is also necessary to understand the thinking and purpose behind the installation of the rail so as to predict possible trajectories and thereby guide the eye