



August 2001

Miniature Concrete Sleepers Dean Brennan

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One of Dean's excellent cast concrete sleepers

Photo by Jim Clark



Around October 1999, Doug Baker and Ernie Redford approached me regarding the possible use of concrete in the manufacture of sleepers for the proposed ground level track. Working as I do in the concrete testing laboratory for Pioneer Construction Materials, I had access to technical expertise, raw materials and testing facilities. Other materials had been considered but the flexibility of concrete as a material and the ability to produce sleepers within the club to our own timetable made it an attractive option.

Concrete is a manufactured product that combines coarse aggregates, (stone) with fine aggregates (sand), a cement binder and water. Concrete sets by a chemical reaction between the cement and water (hydration). In general terms, more water is added than is required for this process to enable the concrete to flow and therefore become workable. Chemical admixtures may be added

(Continued on page 2)

Your Committee

President Ron Date	9246 2835
Vice President Ian Allison	9490 2381
Secretary John Shugg	9246 9549
Treasurer John Martin	9448 8843
Safety Officer David Naesser	9349 0747
Committee Members	
Lindsay Adams	9447 4646
Doug Baker	9341 1630
Jim Clark	9446 5870
Jim Crawford	9276 5464
Nigel Mammatt	9389 5775
Ernie Redford	9446 4513

NDMES
PO Box 681
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Western Australia

CALENDAR OF EVENTS

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General Meeting	Laurie Strutt Park Elvire St, Waterman	8:00 pm	Friday 10 August
Club Run Day and Public Run Day	Club Track Site Vasto Pl, Balcatta	10:00am—4:00 pm	Sunday 26 August
General Meeting	Laurie Strutt Park Elvire St, Waterman	8:00 pm	Friday 14 September
Club Run Day and Public Run Day	Club Track Site Vasto Pl, Balcatta	10:00am—4:00 pm	Sunday 30 September
General Meeting	Laurie Strutt Park Elvire St, Waterman	8:00 pm	Friday 12 October
Birthday Party Run	Club Track Site Vasto Pl, Balcatta	11:00am—1:00 pm	Saturday 27 October
Club Run Day and Public Run Day	Club Track Site Vasto Pl, Balcatta	10:00am—4:00 pm	Sunday 28 October
Bassendean Fair	Ashfield Reserve Bassendean	Set-up on Staurday	Sunday 4 November
Note: There may be additional Birthday Runs or other events scheduled at short notice. Contact Jim Crawford or John Shugg for latest details.			

July General Meeting

minutes of meeting by John Shugg

The meeting opened with visitors Brian Lawrie, David Brown and Stephen Briggs welcomed to the meeting.

GENERAL BUSINESS — Safety Issues. After a brief introduction by the President, the Safety Officer David Naeser spoke about the safety responsibilities of everyone and stressed that each person is responsible for his or her own actions. Safety procedures are particularly important on Public Run days.

David displayed Safe Operating Practice Signs (SOPs). These cover driver and station staff responsibilities. See the article on page 4 for more details.

Standard Dress Code. The Secretary suggested a uniform dress code at public events would make us look a far more professional outfit than at present. Several suggestions were offered. Milton Smith suggested a standard colour scheme rather than a type of uniform. Members are asked to think about the issue and be prepared to discuss and decide this issue at the next meeting. (Top Hats allowed?)

MODEL ENGINEERING — Lindsay Adams displayed and operated a "flame gulping" engine. This was, as usual, finished to a very high standard.

Ken Austin displayed his Britannia frames, all built in stainless steel except the cast iron sleeved piston and piston valve bores. The attention to scale detailing is exceptional. Ken gave a brief and informative talk about the locomotive and his involvement in building traction engines some years back with members of the Rand Society in South Africa.

Doug Baker displayed and gave a talk on pressure gauges and their construction and showed a number he had modified. He also advertised a digital vernier, available for sale.

Phill Gibbons discussed building a 2-½ Gauge loco.

Andrew Manning demonstrated a lathe attachment for slotting shafts, and is using this to make a female spline.

Ron Date displayed his NSWGR 32 Class Boiler. The boiler fittings are nearing completion.

Steve Reeves gave an interesting talk about his 7¼ Gauge Garrett. The chassis for one engine was on display.

RAFFLE - for a magnifying lamp stand was won by **Doug Baker**, who kindly re-donated the lamp stand to the club for a re- raffle at one of the next meetings. The raffle raised \$65 for the Society funds—Thanks to both donor and raffle ticket purchasers!

Concrete Sleepers

article by Dean Brennan

(Continued from page 1)

to modify the behaviour of the mix in certain ways, i.e. to reduce water demand, increase the workability, (flow) or to modify the setting time of the product.

The design of the concrete mix for the sleepers needed to meet certain criteria:

- A minimum compressive strength of 25 MPa
- A minimum flexural strength of 2.5 MPa
- Durability in external conditions
- Ease of placement into small moulds

With a minimum sleeper width of only 44mm, the durability of any reinforcing steel was to be of concern, given the minimal thickness of concrete cover. At 25 MPa, the permeability of the concrete would be quite high and any steel close to the surface would be liable to corrosion. Rather than placing a single 6mm diameter bar within the sleeper, it was therefore decided to experiment with steel fibres. These are small wires with hooked ends and are available in a variety of gauges and lengths. Although they are distributed evenly throughout the concrete, including near the surface, any corrosion that does occur is localised to the individual fibres and would be small in comparison to the effects of corrosion on a 6mm diameter bar running the length of the sleeper.

A set of steel moulds was produced and early trials begun. Trials showed that a combination of both 65mm and 38mm steel fibres in a ratio of 1:3 provided a good distribution of reinforcement within the sleeper. Due to the concerns over the permeability of the concrete it

Standards...

by John Shugg

In relation to the idea of having a standard draw bar, I have made 12 off draw bars (16 x 5mm bar), with holes of ¼ inch at 90mm centres.

As we will be fitting a standard "shroud" between passenger cars, the need for uniformity of design and construction is obvious. We have agreed to draft a standard outline for raised track riding cars and will publish the specifications in Steamlines. Lindsay Adams' latest riding car will be used as the "example".

Things are hotting up over driver registration... Our aim is to conform with all AALS operating codes and meet the requirements of our Insurers. So be prepared for a discussion soon and to sit your theory exam - read your Driver's Licence booklet! Please ask David Naeser or John Shugg for more details.

John Shugg



Northern Districts Model
Engineering Society Inc.

Track Site:-
Vasto Place
Balcatta
Western Australia

All correspondence to:-
PO Box 681
Balcatta
Western Australia 6021

<http://www4.tpg.com.au/users/jimclark>



Anyone for tea? Jim Crawford during
the building of the new club house
Photo: Dick Langford

Safe Operating on Running Days by David Naeser

Members attending the recent running day may have noticed a range of new signs being hung at work zones, such as coach loading areas and the station. These signs were provided, with the Committee's approval, in order to assist us to operate the railway in a safe manner.

The signs are termed "Standard Operating Procedures" (SOPs) [no, not SOBs!] and are intended as reminders for those running the railway as to how it should be run to ensure safe operation. The method is borrowed from industry where such notices are, well *standard operating procedure*. They are placed at workstations and in danger zones to remind workers of dangers and to reinforce safe operating methods.

The thinking behind these is that safe operation cannot be enforced from the top-down, but can only occur if the people doing the job know and are reminded of the correct way to do it. In our case, we can't rely on people memorising fat rule books, nor

expect the Duty Officer or Safety Officer to act as ever-vigilant policemen to prevent unsafe operation. Safe operating has to come from those of us doing the job. We should care for what we are doing and what our colleagues are doing. The use of SOPs will provide a reminder of what we have to do and will help us to point out any operating mistakes or transgressions to others.

The notices are included on a separate sheet with your newsletter and are self explanatory. They are provided as an initial proposal and suggestions for improvements are welcome. The preference is for constructive suggestions, but voice your disapproval too... we do have a democratic club!

We are also implementing a drivers licence policy. As of last running day, only members who have been issued with drivers licence booklets will be permitted to haul paying passengers on Public Running days. Also, only those coaches which meet AALS and club standards can be used for the public. A list of coaches meeting these criteria is maintained by the club, and to assist in identifying these, a "fit for traffic" sticker has been applied to member's coaches stored at the club. (Apologies to members for putting stickers on their coaches... I hope nobody minds!). We also intend to provide a list of such coaches inside the clubhouse. If your favourite driving car or coach is not registered with the club, please see me and I'll be happy to add yours to the register, provided its brakes, couplings and footboard meet AALS and club standards.

As a further note, the Committee has agreed that a Duty Officer will be appointed on a rotational basis for Public Run days, starting with Doug Baker as Duty Officer for the run day on 29 July.

WANTED

Hydraulic Engine Crane or similar, for lifting locos, workshop equipment etc. A unit in need of repair will be fine. Contact Jim Crawford: 9276 5464

Copper Sheet 1/8" (not 3mm!) for boiler construction, various sizes needed. If you have some offcuts or surplus stock, contact Jim Clark: 9446 5870

FOR SALE

Drill Mill single phase as new, this machine has never been used. Complete with tooling, \$2000

Band Saw (woodworkers) 2ft throat, all cast iron, spare blades, \$1500

Woodworkers Bench with vice, bench stop and cupboards, \$100
All the above prices are negotiable.

Phone 9385 8184 or contact Doug Baker on 9341 1630

Do You Own a Hercus?

Over the next three months F.W. Hercus will phase out spare parts for the following machines:

- Hercus 9" Precision Lathe (all models)
- Hercus No.0 Milling Machine (all models)
- Hercus Tool & Cutter Grinder
- All other machines made before 1975.

To help move remaining stocks, all spare parts prices have been reduced by 50%.

For more details please contact: F.W. HERCUS

Phone: (08) 8346 5522 email: axmell@axmell.com.au

Miniature Concrete Sleepers

article by Dean Brennan

(Continued from page 2)

was also decided to increase the strength of the concrete to 40MPa, thus reducing its permeability. The minimum width of 44mm also meant that a maximum aggregate size of $\frac{1}{3}$ of the minimum sleeper width would need to be adopted. 14mm aggregate is manufactured by Pioneer Quarries and a mix design was chosen to utilise this aggregate.

The actual mix proportions were derived from a commercial design that had been used for the production of full size railway sleepers. This particular design also had the benefit of only requiring two aggregates, a 14mm graded granite and a fine sand, thus simplifying both the collection of raw materials and the batching of the mix. To further simplify the batching, the cement content was increased to allow a single pre-packed 20kg bag of Ordinary Portland Cement to be used per batch. This increased the strength closer to 50 MPa.

A chemical admixture known as a superplasticiser was chosen to perform two functions within the mix: firstly, it reduces the water demand and secondly it has a lubricating effect on the cement particles which increases the workability (flow) of the mix and therefore makes it easier to pour into the moulds. As the strength of a mix is related to its water-to-cement ratio, being able to achieve a reduction in water (without the loss of workability) results in a lower water-to-cement ratio and hence a gain in strength.

The final design to produce each batch of 50 sleepers contains the following:-

- 59kg of 14mm graded granite
- 36.5kg of concrete sand
- 20kg of Ordinary Portland Cement
- 6.75 litres of water
- 1.2kg of steel fibres
- 220ml of superplasticiser

Having formulated the concrete mix, the last items required prior to production were the holding down bolts. Stainless steel studding was chosen to minimise corrosion and proved to be less expensive than was first thought. The studding for the sleepers was arranged by Ernie Redford and with the aid of a motor driven bending jig devised by Ernie, the cut lengths of studding were given a 45 degree crank to help secure them in the concrete. 10,000 studs are required for the sleepers and a few hundred more for the turnout ties.

When casting a set of sleepers a mould release oil is first applied to the steel moulds. The studding is then installed into position within drilled bolts screwed into

the base of the moulds. The bolts, once unscrewed, leave the studding exposed and free to allow easy removal from the moulds. The concrete is batched and placed into the moulds, which are mounted upon a vibrating table to facilitate the compaction of the wet concrete. Any stray steel fibres are coaxed back into the mould from around the edges and the concrete surface trowelled off. The moulds are placed on a level surface and cured for up to 7 days prior to sleeper removal.

When casting sleepers, two quality control test cylinders are cast with each batch. These are compression tested at 7 days and 28 days and a record of the results kept. Results to date have shown strengths in excess of 60Mpa. As a rule of thumb flexural strength is generally about 10% of the compressive strength. This was confirmed by bending tests on initial sleepers, which yielded results in line with this.

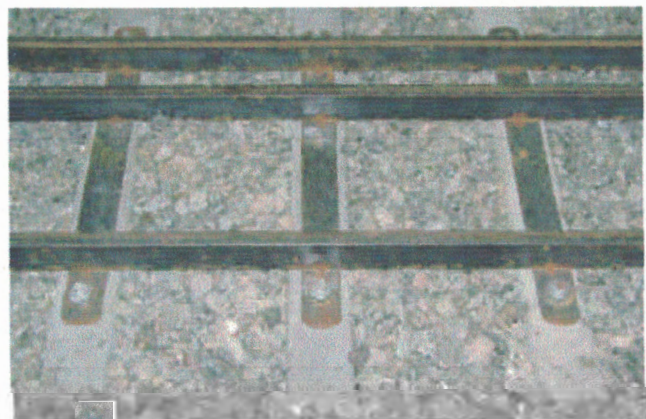
For the turnout ties a special set of moulds was constructed by Ernie due to the differing lengths and bolt positions. These are cast as an addition to the normal 'standard size' sleeper run.

To date, just over 2,000 sleepers have been poured, together with the tie sets for 3 turnouts. Now that the process is well rehearsed, the next 3,000 sleepers should not be so long in the making!

As a final note I would like to thank the following for their assistance and support: -

- **Pioneer Construction Materials** – for technical advice, production / testing facilities and aggregates
- **Cockburn Cement** – for cement products
- **Master Builders Technologies** – for technical advice and chemical admixtures
- **Ernie Redford** – for his assistance with moulds, studding, modifications and general encouragement.

Dean Brennan



A trial section of track was constructed and ballasted as a display during the initial stages. The response from all who have viewed it has been very positive.
Photo: Jim Clark

"Mary Poppings" Calorific Engine Article & photos by Jack Watson

Two hundred and forty two years ago, in 1759, Henry Wood, the Vicar of High Ercall (UK) patented his invention which he described as a means for "Working a Fire Engine upon a New Principle different to any Method heretofore used ...".

Living in a mining area, Wood was familiar with the Newcomen engines, and his idea was along similar lines, but he intended to eliminate the steam from the cycle. Why go to the trouble (and danger in those days) of using the energy of the flame to heat water to produce steam, which was then transferred to the cylinder, when the burning gas of the flame itself could be introduced directly into the cylinder to accomplish the same end?

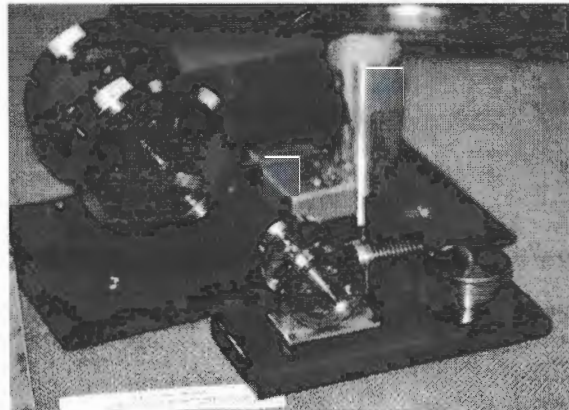
I have found no reports of Wood's having actually built such an engine. It was not until 48 years later, in 1807, that Sir George Cayley built a working model. By 1870, thousands of these external combustion "Caloric" or "Hot Air" engines were produced, (not to be confused with the Stirling cycle hot air engine, invented by yet another village parson in 1816!).

These Caloric Engines proved to be reliable, easily operated and more economical of fuel and safer than comparable steam engines, considering the materials available to boilermakers of the day, when boiler explosions were not uncommon workplace hazards.

These "external combustion" engines suffered the disadvantages of large size and weight for the outputs achieved, from heavy wear in the cylinders from ash and from distortion and failure of the piston from the direct flame. Metallurgy of the time was not up to their demands.

A copy that I have of an 1871 advertisement for the Roper Caloric Engine (see inset) quotes the one horsepower engine at 80 to 90 revolutions per minute, as weighing one ton and having a bore and stroke of 12" each!

They were eventually superceded by the more efficient gas fuelled internal combustion engine and the high pressure steam engine. Of course, the weight and bulk penalties disappear when one considers that no boiler is necessary for a calorific engine.



My original model beside another, which a friend had made by a professional engineer after seeing my engine. The other engine is scaled up 3 times.

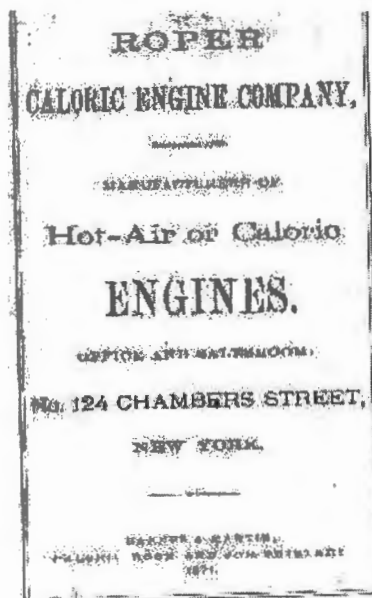
My interest was fired by an article by Dr. Senft in the November 1980 edition of "Live Steam", so after thinking about it for nearly 20 years, I built a model based on his "Poppin".

I used BA threaded fasteners in place of the American threads, which entailed some dimensional modifications. My valve rod is a piece of bicycle spoke, the reed valve is a piece of two-thou feeler gauge, and the cast iron for my piston and cylinder was originally a sash window counterweight.

Considering the miniscule power output of the model which has a bore of 3/4" and a stroke of 7/8", it was necessary to minimize friction as much as possible. To this end, I used ball races for the main bearings - from a Woodwood UG8 governor from the last diesel Power House I worked at!

The piston, which has a wall thickness of 0.040", has no rings, and was lapped with Brasso to give the best possible fit to the cylinder.

The crankshaft was built up from stainless steel and the webs pinned with 1/16" roll-pins. The 1/8" dia. rocking shaft was cross-drilled and tapped 10BA, and runs in bronze bushes. The valve is actuated through a cam follower, which has a hardened steel roller.



These engines are frequently referred to as "Flame Gulpers", "Flame Lickers", "Caloric" or "Atmospheric" engines, and are more properly described as Vacuum engines. Simply described, the cycle of operation is that the reed valve opens at the beginning of the outward movement of the piston, which draws the flame into the cylinder. At the bottom of the stroke the valve closes. The hot gas trapped in the cylinder rapidly cools, forming a partial vacuum, and atmospheric pressure on the exposed back of the piston pushes it inwards again.

Towards the end of the power stroke, the reed valve opens to exhaust the cooled gas, when the "two stroke" cycle is repeated. They are not self-starting, and rely upon the flywheel to maintain the cycle of operation.

The flame may be from any convenient source, such as bottled gas, or any lamp with an exposed flame. The prototype used any cheap burnable material - wood, coal, and even cow dung. For my model, I decided against cow dung, and use a methylated spirits wick burner. My engine is air cooled, but I have seen hopper- (water) cooled examples.

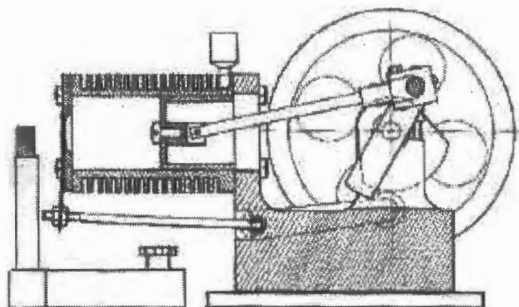
This little engine makes a merry popping sound, so I have named her "Mary Poppings". I have shown her on many occasions since I built her in two weeks of 1998, and I never cease to be fascinated by the magic of the thermodynamics that take place within a millisecond or so each revolution to produce sufficient power to maintain the cycle.

I would like to think that Henry Wood could get as much pleasure in watching "Mary Poppings" run as I do, some two hundred and fifty years after he first envisioned her!

References: "Poppin", by Dr. J.R. Senft, Live Steam, pp 6-12, November 1980

"Internal Fire" by Lyle Cummins. pp14-17.

Jack Watson



Char Supplies **by Jim Crawford**

There has been some discussion regarding the ongoing availability of this Victorian fuel. I recently contacted Australian Char's Head Office in Dandenong and was advised that production was, in fact, being increased. They have a developing export market, including supplying Denmark (not the one on our South Coast). So, no problems with supply for the foreseeable future, and that's the good news.

Unfortunately, the not-so-good news is that the price has risen by around \$60.00 per tonne, including GST. The road freight within Victoria is now \$35.50. This is a rise of \$20.50, although I suspect on our original order we may have been undercharged in this respect. However, I can still arrange transport from Melbourne at the original \$100.00 per tonne to Perth. Some Members of NDMES indicated to me that they were interested in buying a supply for their own purposes. Should this still be the case, it can be arranged.

To Members who are not familiar with Char, it is a proven first class steam producer with a calorific value way in excess of Collie coal. It seems ideally suited to the smaller scales (3-1/2"G and 5"G), which do tend to suffer from tube blockage and significant smoke emission when burning the local product. Larger 7-1/4"G locos do not seem so affected with blockages and even smoke is at an acceptable level, possibly due to more efficient combustion in the capacious fireboxes.

The only negative with the use of char that we are aware of, is the tendency to produce a pretty good pyrotechnic display. This requires the fitting of an effective spark arrester, so that the ride is a little less memorable to the passengers and our own fire-fighters are not too pressed either. On the plus side, a char burning loco usually steams very freely and is a breeze to clean afterwards.

In my own experience Railmotor, (TAFKY 2) has not been touched by a flue brush for twelve months. Cleaning involves a quick squirt with the compressor air gun. Compare this to a hard flue brush and frequent scraping to remove solid deposits from tubes and firebox plates, it has to be much kinder to your copper boiler. I can only suggest that you give it a try, I doubt you will be disappointed.

The Society still has around 0.5 of a tonne of the original order available on site, so if you need fuel please see Jim Crawford, John Shugg or Doug Baker. The char can be purchased in either a 75/80kg drum or a 7kg bucket.

Jim Crawford