SECTION 410 TRAM TRACK DESIGN CRITERIA

SPECIAL CLAUSE SC411

A glossary of tramway design terminology is attached as Annex J. The Drawings referred to in this Clause are attached as Annex K.

1.0 Horizontal Geometry

1.1	Track Gauge	1.435 for straight track or curved track with a radius over 40 metres.
1.2	Track Centre	Minimum of 4.000m for track with centre poles. Track centres may reduce to 3.353m with side support poles. Track centres may need to be increased to provide sufficient clearance between trams on track curves.
1.3	Minimum Radius	350m. The number of horizontal curves is to be minimised. Where curves are necessary, the radius is to be as large as possible within the design constraints. *Curves with radius under 350 m need guard plate to be attached and need to be pre-bent before installation according to special rail bending diagrams to be provided by the PTC.*
1.4	Curve Design	*The approach to curve design depends on the intersection angle and on the resultant minimum clearance between trams (see Clause SC411 4.0). The limits below provide a rough guide only.*

Concentric	when radius > 100m
Identical	when radius > 50m and < 100m
Separate	when radius < 50m

1.5	Minimum Straight Between Reverse Curves	10 m
1.6	Length of Transition	Sufficient to develop desired superelevation at a rate not exceeding 18mm/10 lin m or 1/600.
1.7	Superelevation	All horizontal curves shall be superelevated. This superelevation shall be determined to balance the centrifugal force of the tram against the component of gravitational force provided by the superelevation. However the maximum superelevation shall be 100 mm.
1.8	Design Speed	80 km/hr

2.0 Vertical Geometry

The number of grade changes shall be kept to a minimum and the grade shall be as flat as possible subject to the minimum grade requirement.

Maximum Grade	6.67% (1 in 15)
Desirable Minimum Radius	760m
Absolute Minimum Radius - Sag Curve	300m
Absolute Minimum Radius - Hog Curve	260m
Minimum Grade	0.25%

The grade line for the tram track shall be designed separately for each track and shall be independent of the vertical road alignment. The exception to this requirement is that track levels must match road levels at road crossings.

3.0 Cross Sections

3.1 Drawing No TD1 shows typical cross section details of concrete to surface for 4000mm track centres. This applies to the general trackwork in the median except where tram stops and road crossings occur.

3.2 Drawing No TD2 shows the standard details for drop margins at road crossings.

3.3 Drawing No TD3 shows the standard details for tram stops.

3.4 (i) The following level differences apply on straight track:-

Inner rail above outer rail	6mm
Outer rail above margins	13mm
Between inner rails	50mm (desirable)
	20mm (minimum)
	100mm (maximum)

Refer to Drawing No LD1, Sketch (i)

(ii) Although the inner rail will normally be 6mm above the outer rail, the slope may be reversed for one track so that the whole slab slopes down from left to right or right to left where there is a steep crossfall, eg street crossings. Refer to Drawing No LD2, Sketch (ii).

(iii) Where there is cross traffic, the four rails should be kept in one plane where possible. Refer to Drawing No LD3, Sketch (iii).

4.0 Clearances

Drawing No P15556 shows the minimum clearance standards for tramways. All structures must conform with these standards. Specific applications of these clearance standards are set out below.

4.1	Between passing trams	Minimum 600mm.

Drawing No T1 shows dimensions of a tram.

4.2	Between tram and centre pole	Minimum 450mm.
4.3	To temporary structures	Minimum 1120mm (from edge of the nearest running rail).
4.4	To permanent structures	Minimum 1420mm (from edge of the nearest running rail).
4.5	To traffic signals	Minimum clearances for 3 aspect and 6 aspect signals as per Drawings No P864030 and P864031 respectively.
4.6	To hand rails and weld mesh fencing	Minimum clearance as per Drawing No 172553. The minimum clearance between the the line of kerb and the nearest face of fence or handrail is 500mm.
4.7	To passenger shelter (roofed)	As shown On Drawings No S1, S2, S3 and S4.

5.0 Special Work

5.1 Crossover

Drawings to be supplied.

5.2 Turnout

Drawings to be supplied

5.3 Horizontal Curves Below 350m Radius

Upon receipt from the Consultant of final horizontal designs, the PTC will prepare the rail bending diagrams necessary to let its own rail construction contract.

6.0 Drainage

Track drainage shall be provided at all track points (refer to glossary of terms) and low points on the gradeline.

Track drainage design shall be as per Clause SC401 (d) (1) - Surface Drainage, and shall be integrated with the road drainage system.

Track drainage will be provided at the uphill end of tramstops where the above

criteria do not provide a drainage point within 300m of the tramstop.

7.0 Tramstops

7.1 Location — Tram stop locations are as shown on the concept plans - Drawings No P16611C to P16613C, P16614D, P16615A, P16616B and P16617B. Tram stopping studs indicate the position at which trams must stop. The location of the stopping studs is shown in Drawing No *.

7.2 Length — As per Table 411.1

7.3 Width — Minimum width from running edge to line of kerb is 3.4m. If necessary this maybe reduced to an absolute minimum of 2.1m by agreement with VIC ROADS and the PTC.

7.4 Paving — Drawing No TD3 shows the track slab at tram stops. An 800mm concrete margin is provided beyond the running edge of rail. Tram stops will be paved:
- from the margin to the back of kerb when the distance from running edge to line of kerb < or = 4300mm.
- the margin plus 2000mm when the running edge to line of kerb > 4300mm.

Tram stops will be paved so as to be visually different from surrounding concrete, and conforming with the landscape design.

7.5 Fencing

Panels — Fencing panels shall be 1200mm high weld mesh roll top with verticals at 50mm centres and horizontals at 150mm centres.

Location — Where paving is full width to the back of kerb the fence shall be located 500mm from the line of kerb.

Where paving is 2000mm wide the fence shall be located at the boundary between paving and landscaping.

Length — The number of uncut panels required to extend the length of the tram stop.

7.6 Shelters — Shelter requirements are listed in table 411.1. All passenger shelters shall be Australian Posters design. (refer to Drawing No S5 for shelter dimensions).

The location of the shelter within the tram stop area shall be as shown in Drawing No L2.

Underground conduits are to be provided for power supply to lighting within the shelters. The Drawings shall show the location of these conduits. The power supply source will be determined by the street lighting design.

7.7 Drainage

In general, paving should be designed to drain away from the track. At road crossings, however, road design requirements shall take precedence.

Table 411.1

SECTION 420 SIGNAL AND STREET LIGHTING DESIGN

SPECIAL CLAUSE SC421

The traffic signal layout shall be in Microstation.dgn format and shall conform to the drafting symbols and standards as contained in the VIC ROADS TM>CEL computer file.

Colours, levels, lineweights and styles shall conform to Table 19.4.0 in 'Final Drawings Guidelines' Draft February 1993. All services are to be included on the drawings.

A typical Traffic Signal Layout Drg No. 904000 is shown in Annex F.

At signalised intersections joint use of SEC poles with signal lantern assemblies or joint use signal/lighting poles shall be used wherever possible to minimise the number of poles at the intersection. Consideration is to be given to the joint use of tram power supply poles.

The Consultant shall design the Street Lighting in close co-operation with both the appropriate electricity supply authority and VIC ROADS and submit the design to the VIC ROADS Street Lighting Committee for approval.

The street lighting design shall be prepared in accordance with Public Lighting Code AS 1158.1 - 1986, A2 Level.

In designing the installation of road lighting, due regard shall be taken of VICROADS policy on use of frangible lighting poles. This policy is detailed in sections 5 and 6 of the 17th June 1991 draft document entitled "VICROADS Guidelines for the Lighting of Arterial Roads".

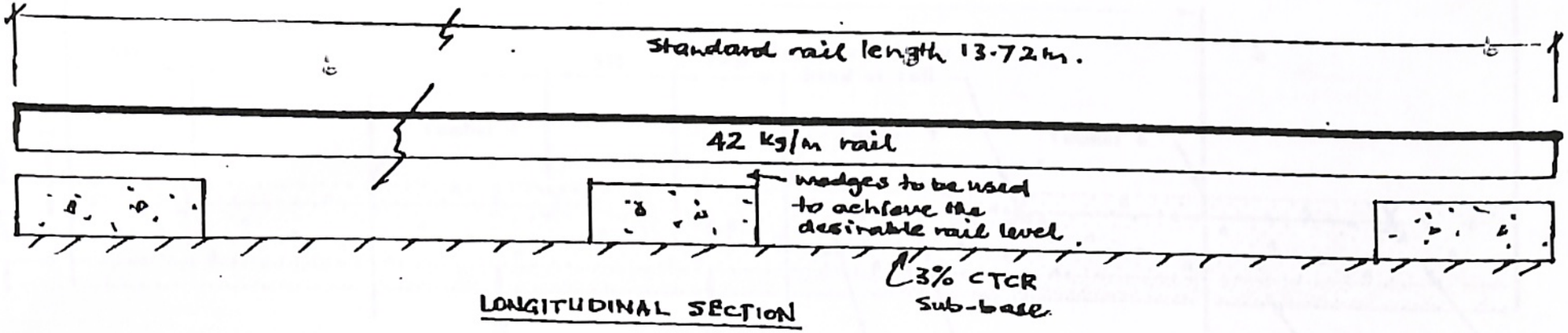
The Alignment Drawings shall show the location of the underground electrical conduits for all signal installations and street lighting.

ANNEX K

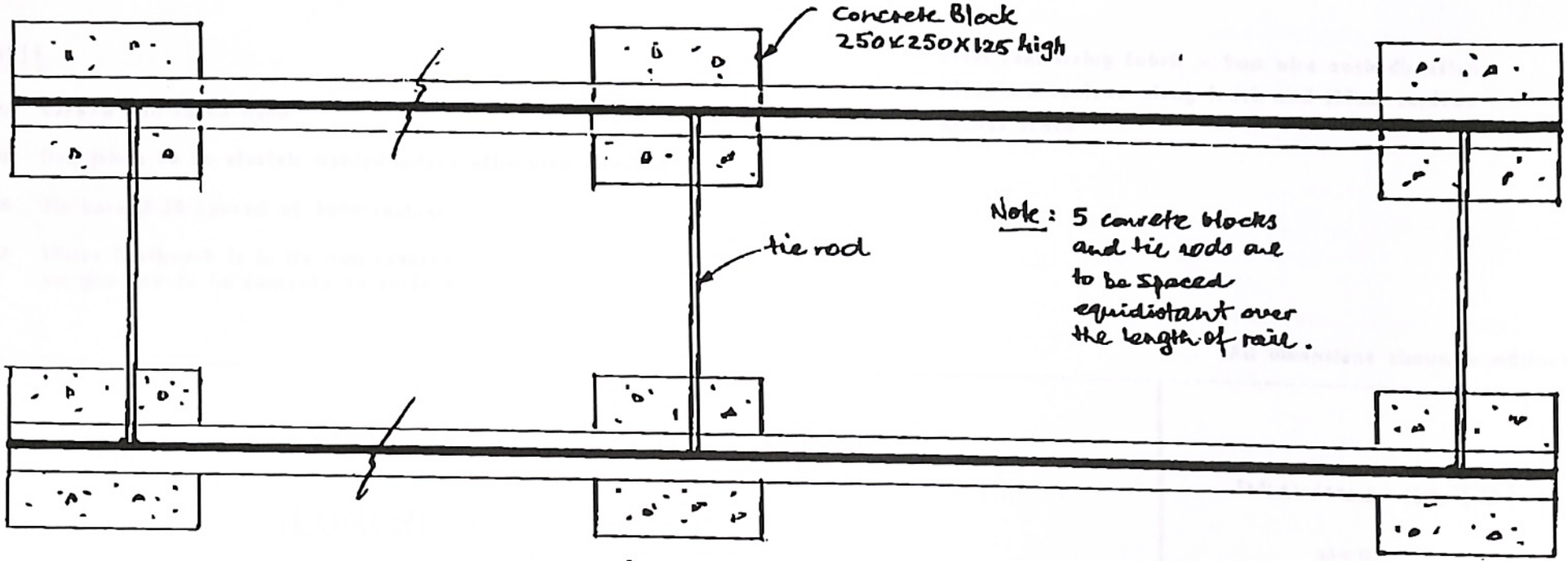
SPECIFIC TRAM TRACK DRAWINGS

DRAWING NO	TITLE	
RS1	Rail Supporting System	
TD1	Typical Tram Track Cross-section	
TD2	Typical Tram Track Cross-section at Road Crossings	
TD3	Typical Tram Track Cross-section at Tram Stops	
LD1	Straight Track Rail Level Differences	
P15556	Minimum Clearances to Structures for Tramways	
T1	Tram Dimensions	
172553	Tramway Reservation with Safety Zone	
P864030	Arrangement for 3 Aspect Lanterns at Tram safety Zone	
P864031	Arrangement for 2-6 Aspect Lanterns at Tram Safety Zone	
S1	Tram Shelter Clearance - Standard Shelter Standard Clearance	
S2	Tram Shelter Clearance - Standard Shelter Minimum Clearance	
S3	Tram Shelter Clearance - Roof Cut Back	
S4	Tram Shelter Clearance - Shelter Without Sidewall	
S5	Tram Shelter Dimensions	
L1	Location of Tram Stopping Studs	To be supplied when required
L2	Location of Tram Shelter Within the Paved Tram Stop Area	

RAIL SUPPORTING SYSTEM FOR CONSTRUCTION



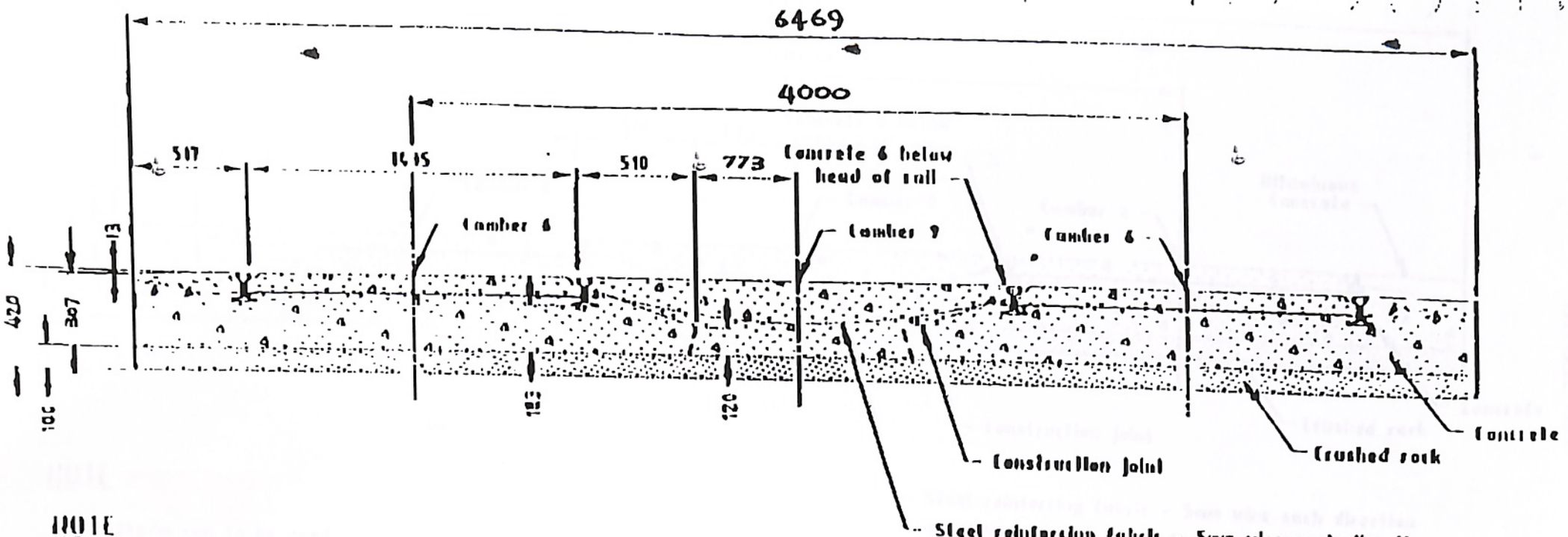
LONGITUDINAL SECTION



PLAN VIEW

DRAWING No RS1
NTS

4.FEB.1998 11:35 MAUNSELL MELB 61 3 96547117 MAUNSELL MELB NO.632 P.9/24



NOTE

- 47kg/m rail to be used
- Rail joints to be electric welded unless otherwise directed
- Tie bars ø 20 spaced at 3000 centres
- Where trackwork is in its own reserve margins are to be concrete to surface

All dimensions shown in millimetres

TRACK DESIGN

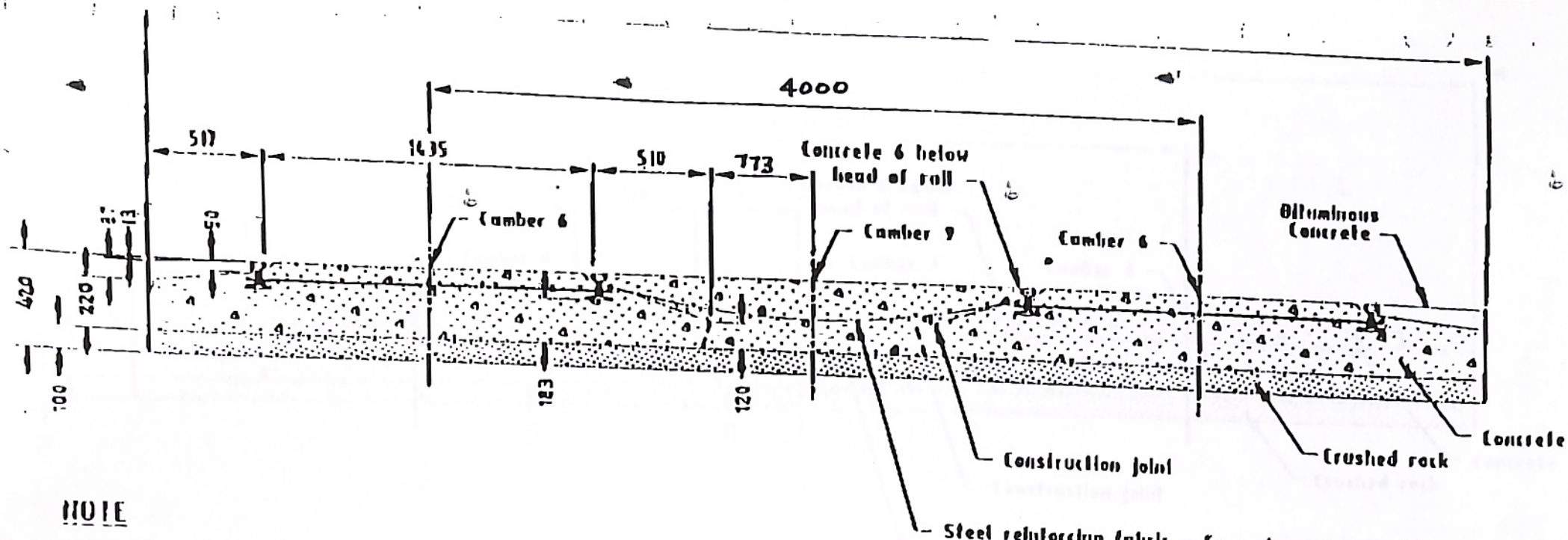
CONCRETE TO SURFACE

4.000m CENTRES WITH 47 kg/m RAIL.

DRAWING NR TD1

NTS.

4.FEB.1998 11:35 MAUNSELL MELB 61 3 95547117 NO.632 P.10/24
MAUNSELL MELB



NOTE

- 42kg/m rail to be used
- Rail joints to be electric welded unless otherwise directed
- Tie bars ϕ 20 spaced at 3000 centres
- Where trackwork is in its own reserve margins are to be concrete to surface

All dimensions shown in millimetres

TRACK DESIGN

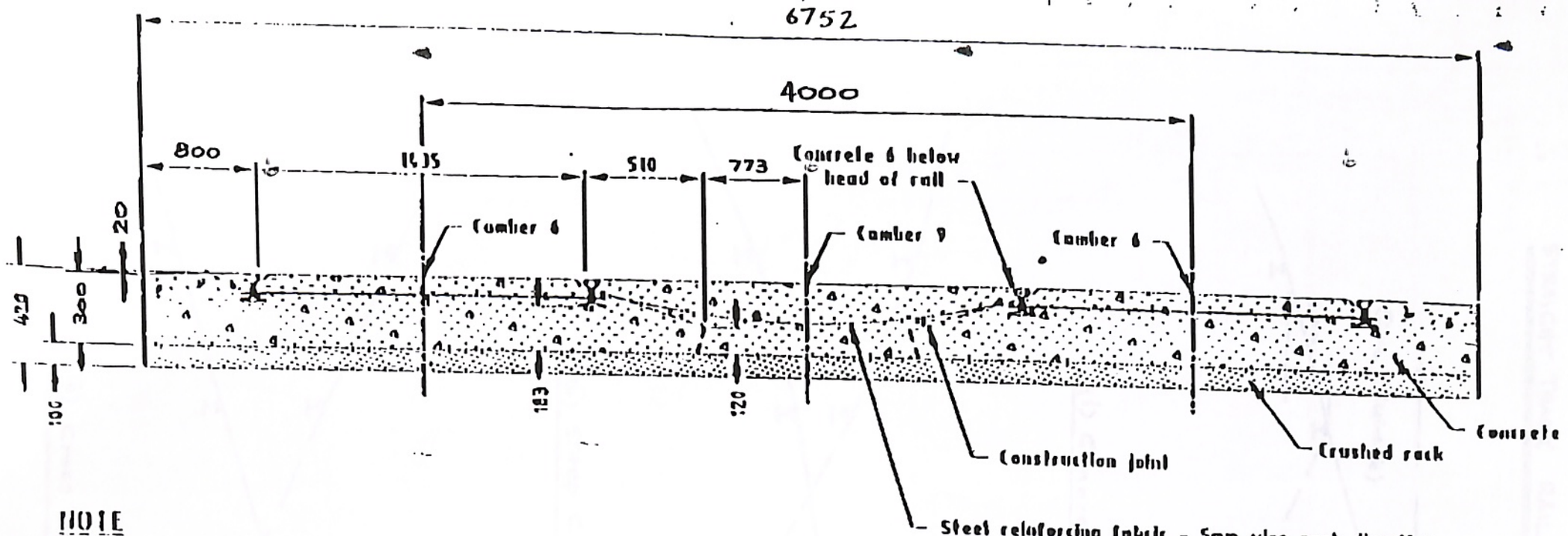
CONCRETE TO SURFACE (AT ROAD CROSSINS)

4.000m CENTRES WITH 42 kg/m RAIL

DRAWING No TD2

N.T.S.

4.FEB.1998 11:35 MAUNSELL MELB 61 3 9547117 NO.632 P.11/24
MAUNSELL MELB



NOTE

- 42kg/m rail to be used
- Rail joints to be electric welded unless otherwise directed
- Tie bars ø 20 spaced at 3000 centres
- Where trackwork is in its own reserve margins are to be concrete to surface

All dimensions shown in millimetres

TRACK DESIGN

CONCRETE TO SURFACE (AT TRAM STOPS)

4.000m CENTRES WITH 42 kg/m RAIL

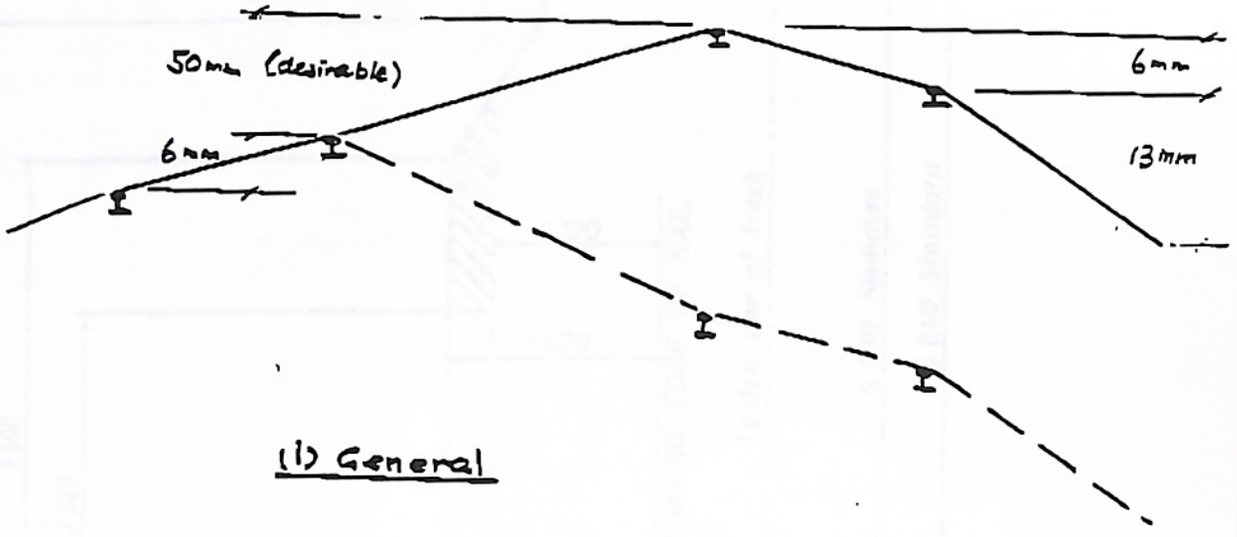
DRAWING No TD3

N.T.S.

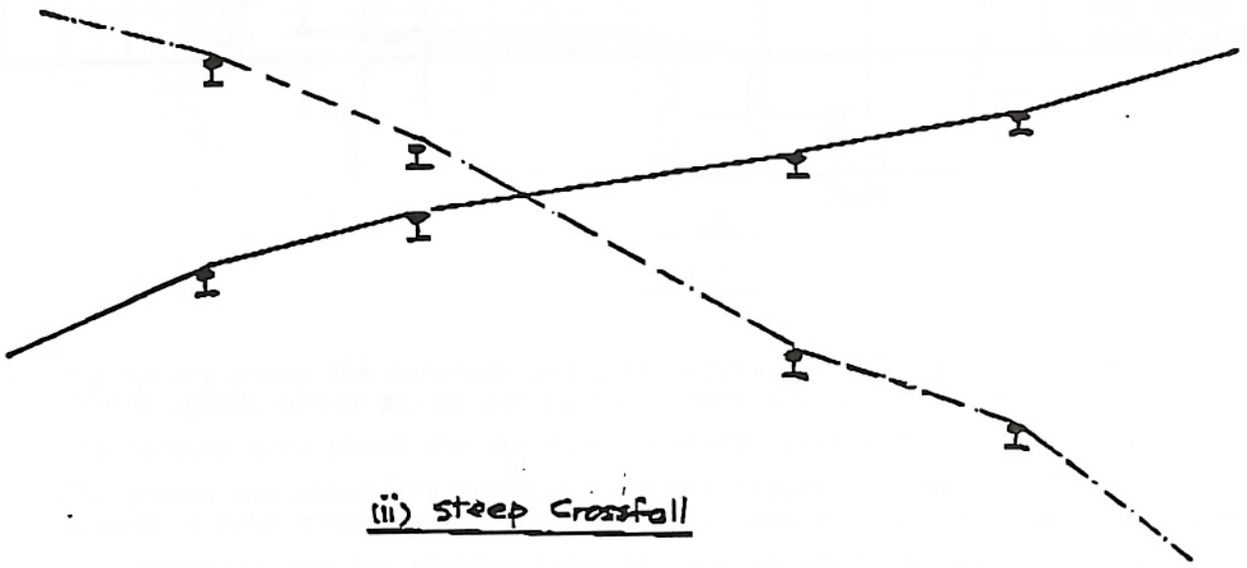
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MAUNSELL MELB

STRAIGHT TRACK RAIL LEVEL DIFFERENCES

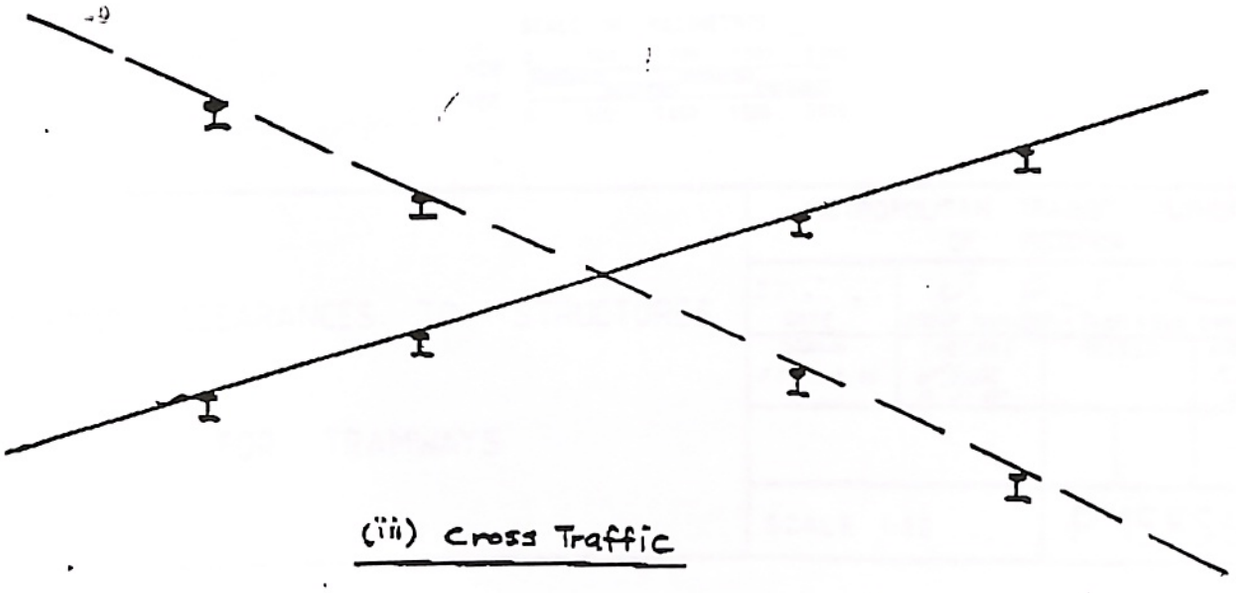
(N.T.S.)



(i) General



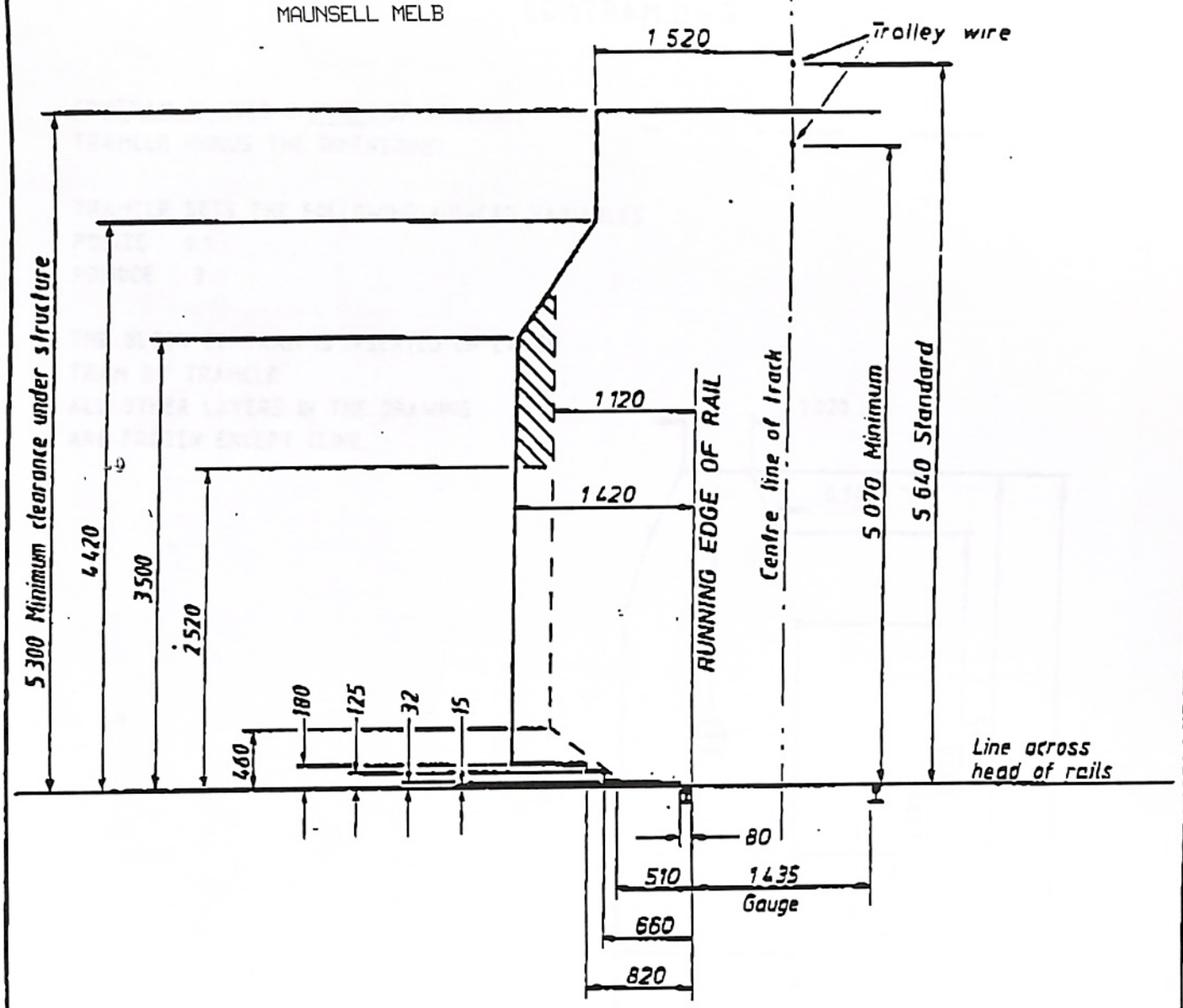
(ii) Steep Crossfall



(iii) Cross Traffic

DRAWING NO. LD1

MAUNSELL MELB



NOTES

1 The full line shows the minimum clearance required for any permanent construction. (Traffic signals, safety zones and separation bars excepted)

2 The hatched area shows the minimum clearance required for traffic signals.

3 The broken line shows the minimum clearance required for temporary construction subject to prior arrangement with the Authority and with special operating precautions.

4 The clearances are for straight track only and an additional lateral distance, varying up to 0·6m, is required on curves. This additional distance can be obtained from the Authority on request.

SCALE IN MILLIMETRES

HOR	0	500	1000	1500	2000
VER	0	500	1000	1500	2000

MINIMUM CLEARANCES TO STRUCTURES FOR TRAMWAYS

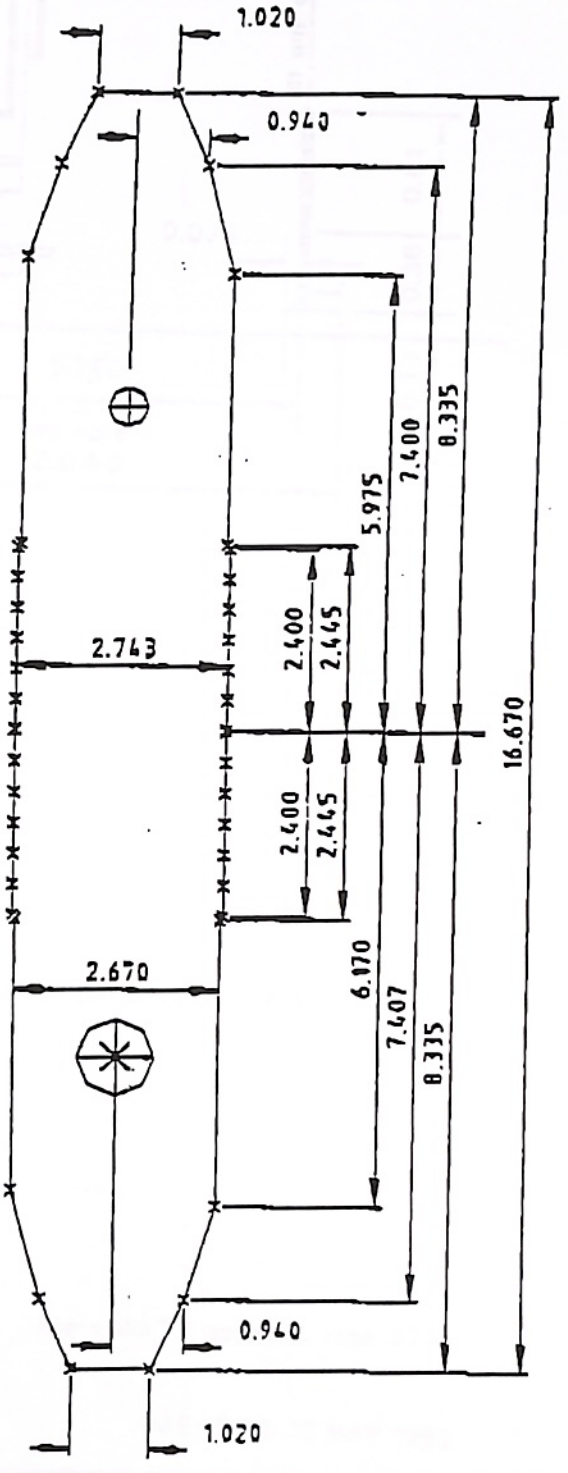
METROPOLITAN TRANSIT AUTHORITY OF VICTORIA

DATE	GROUP MANAGER - TRAM & BUS ENGINEERING		
DRAWN F.E. 11-8-88	CHECKED	PASSED	APPROVED
SCALE 1:50	P.15556		

COMTRAM IS USED IN THE LISP PROGRAM
TRAMCLR (MINUS THE DIMENSIONS)

TRAMCLR SETS THE FOLLOWING AutoCAD VARIABLES
PDSIZE 0.1
PDMODE 3

THE BLOCK COMTRAM IS INSERTED ON LAYER
TRAM BY TRAMCLR
ALL OTHER LAYERS IN THE DRAWING
ARE FROZEN EXCEPT CLINE.

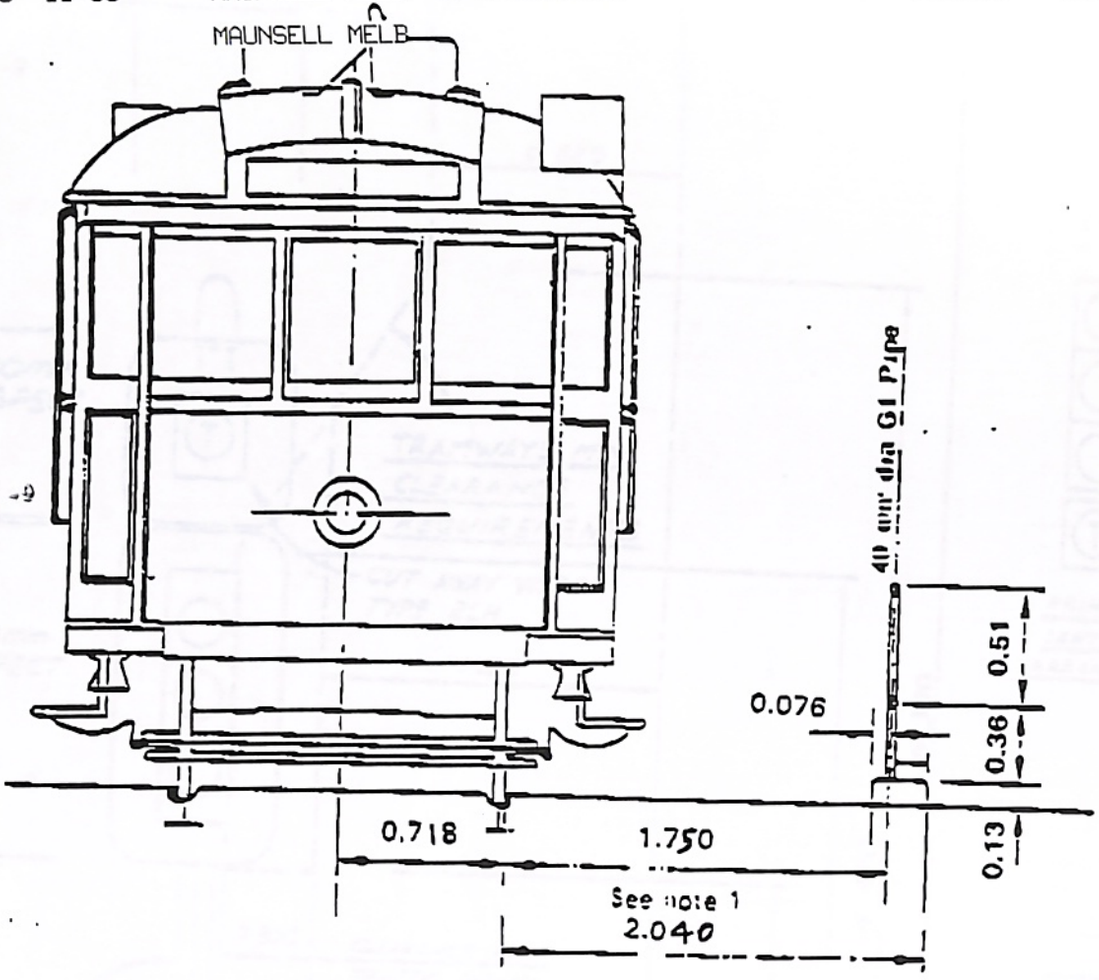


DRAWING No T1

COMTRAM HAS THE FOLLOWING LAYERS :-

BOGIES	white	the tram bogies
CORNERS	blue	middle of the step
	yellow	shows the edge of the side step
	red	shows the corners of the tram

PLOT 1 - 1



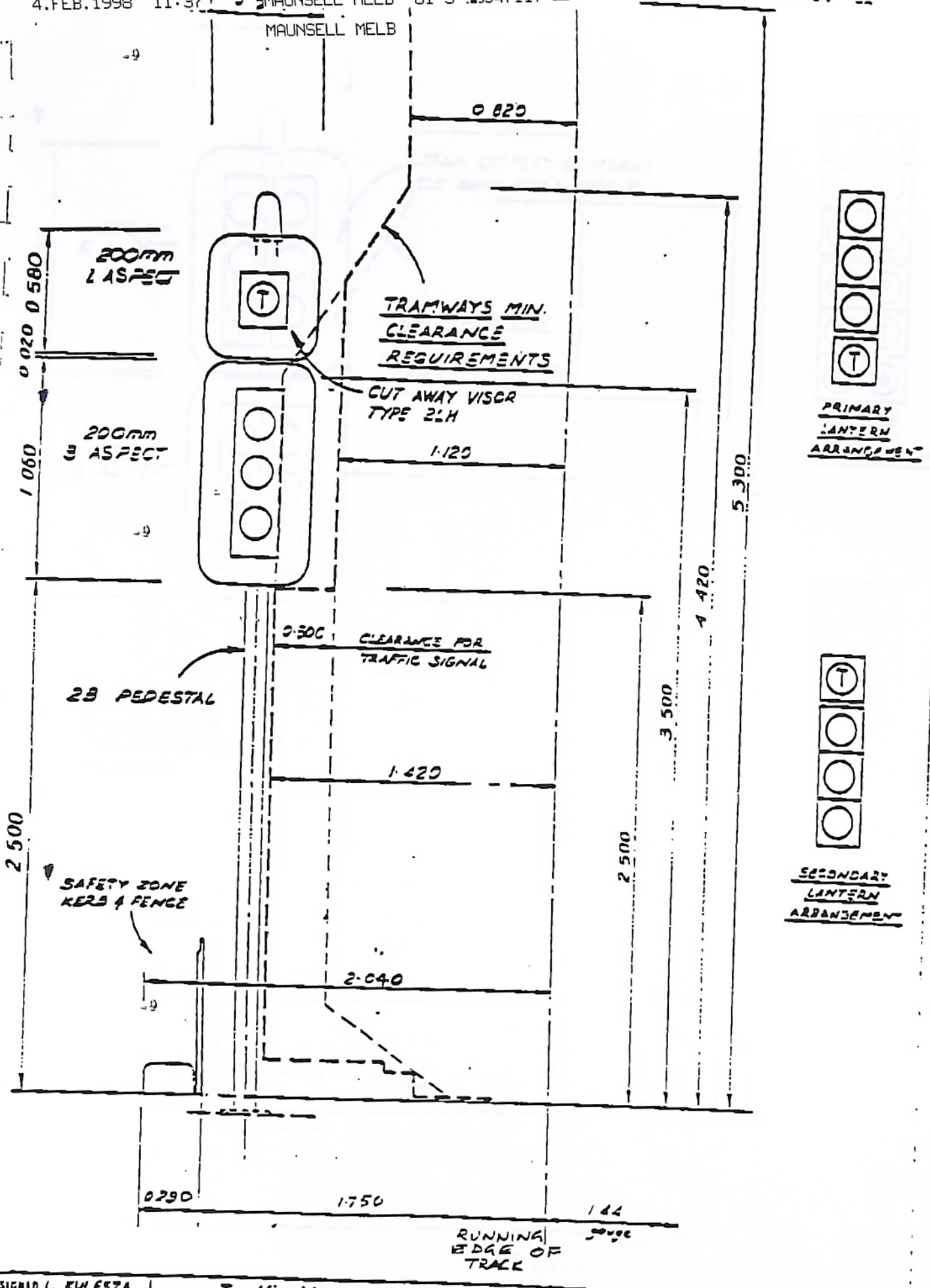
NOTE :-

1. The width of the zone depends largely on the number of pedestrians it must store, and should be increased accordingly.

Where MMTB appears, read MTA

AMENDED 22 MAY 1983

ROAD CONSTRUCTION AUTHORITY	DATE
TRAMWAY RESERVATION WITH NO SAFETY ZONE (Traced from MMTB plan and measurements converted to metres)	PLAN NO. 172553



DESIGNED L. KULESZA

DRAWN L.H. 10/86

TRACED

CHECKED

ISSUED

Traffic Management Division

ARRANGEMENT FOR 3 ASPECT LANTERNS AT TRAM SAFETY ZONE

USING 28 PEDESTAL

ROAD TRAFFIC AUTHORITY

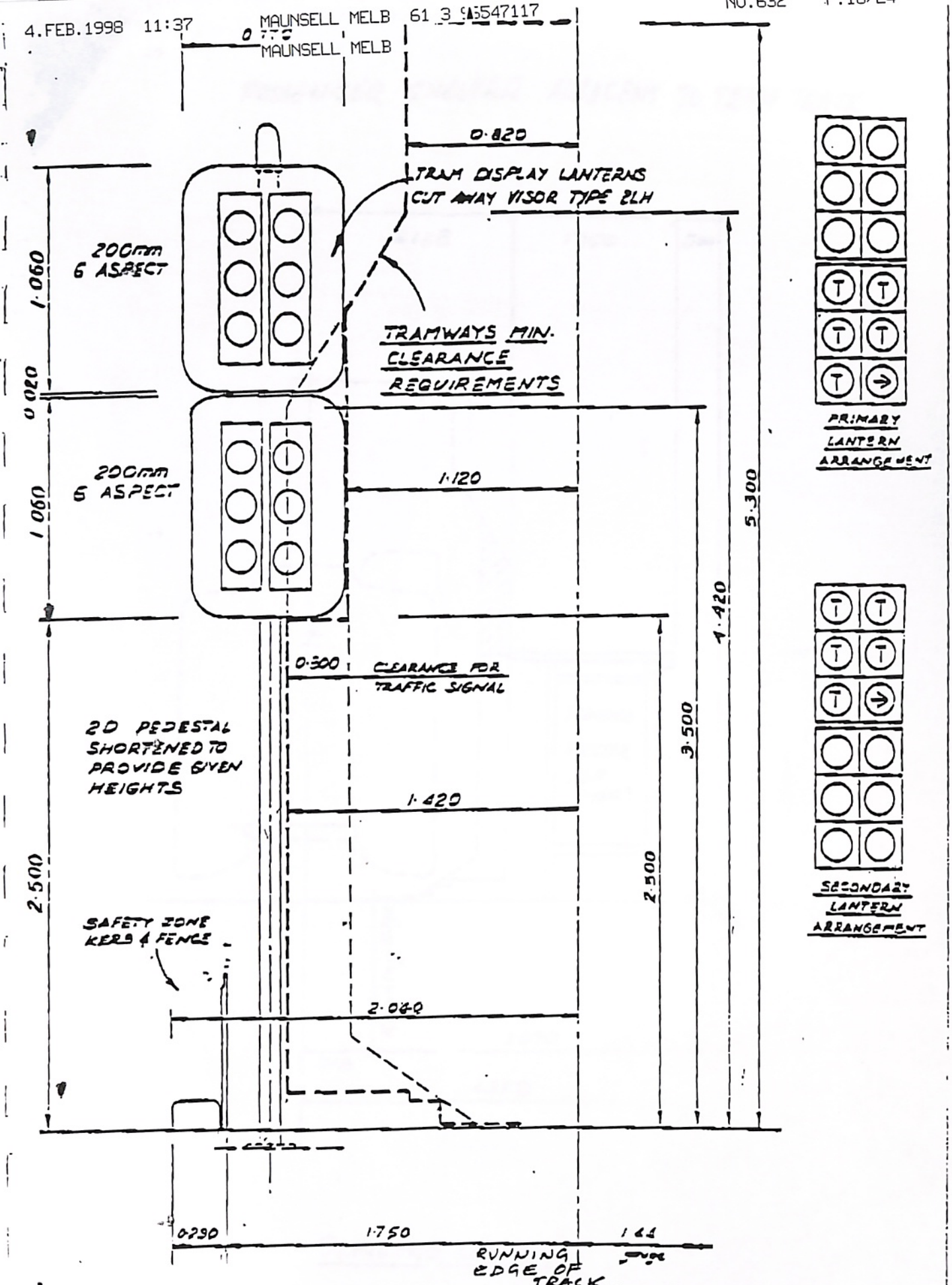
SCALE OF METRES

FILE No.

SHEET

DRAWING No. P 864030

4.FEB.1998 11:37 MAUNSELL MELB 61 3 9[redacted]7117
MAUNSELL MELB



DESIGNED L. RULESTA
DRAWN L.M. 10/86
MANAGER
DRAFTING
SECTION
LEADER
GROUP
MANAGER

Traffic Management Division

ARRANGEMENT FOR 2-6 ASPECT LANTERNS AT TRAM SAFETY ZONE

LONG SHORTENED TO PEDESTAL

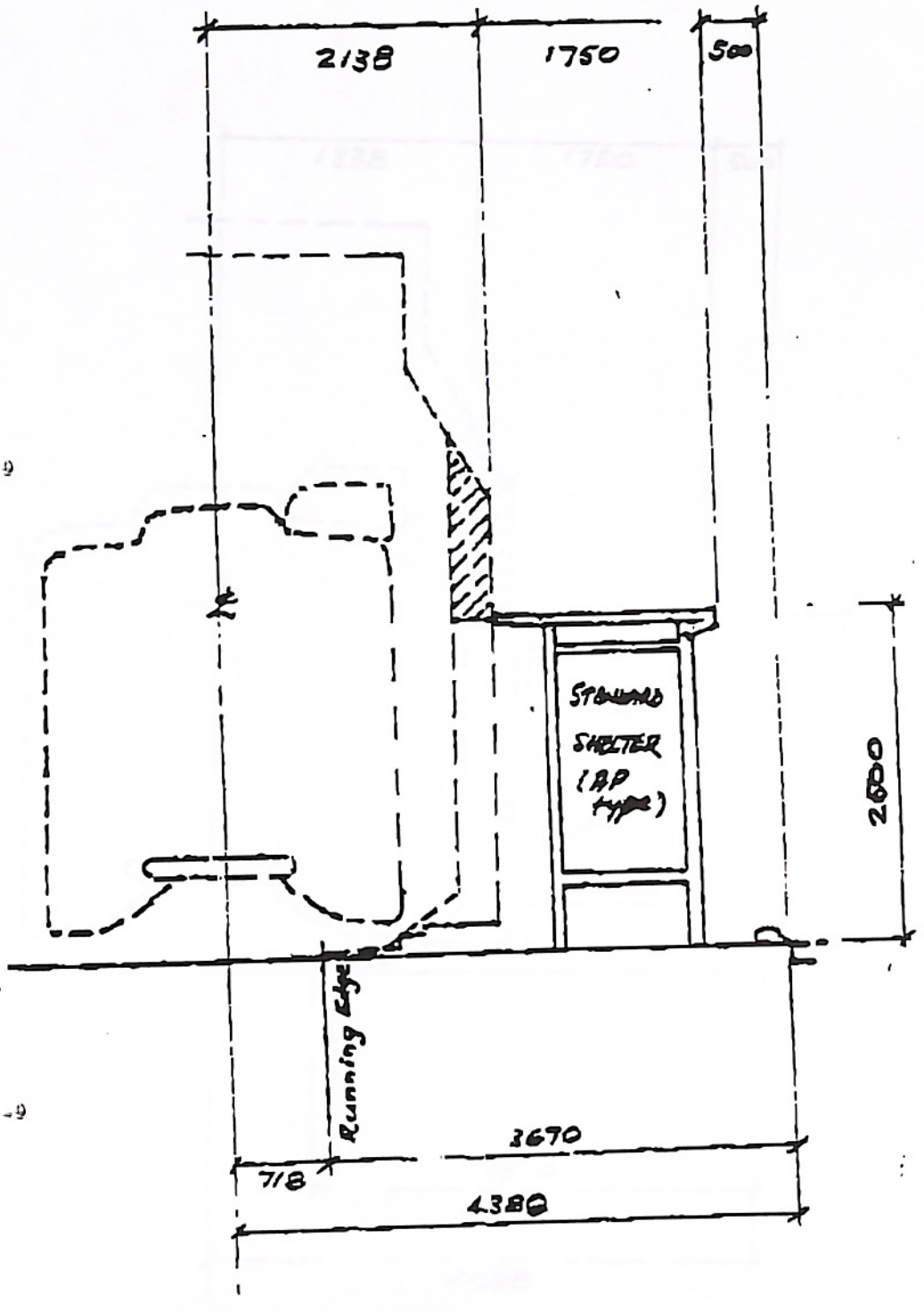
ROAD TRAFFIC AUTHORITY

SCALE OF METRES 0 0·1 0·2 0·3 0·4 0·5

FILE NO. SHEET

PLAN NO. P86 403/

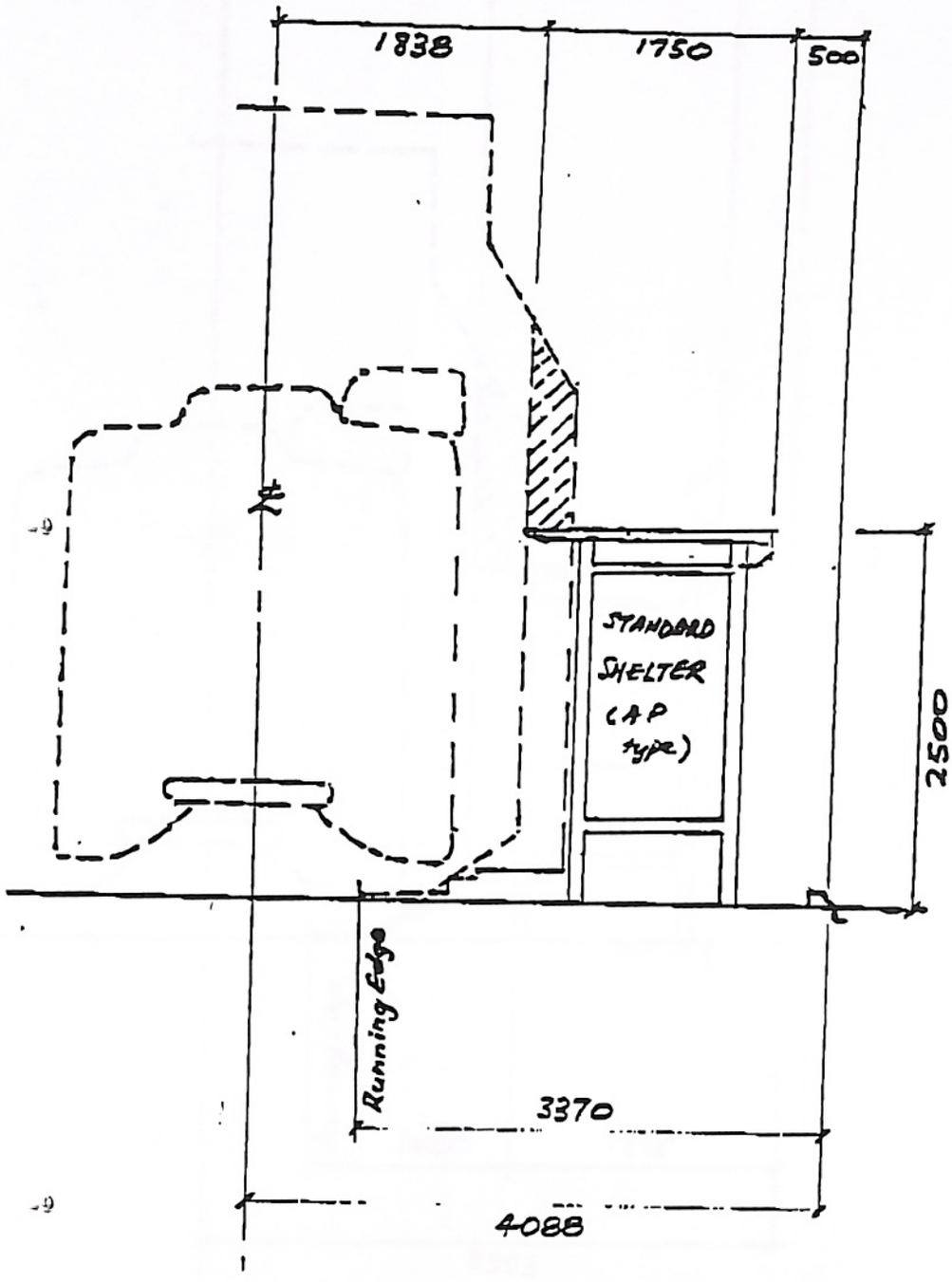
PASSENGER SHELTER ADJACENT TO TRAM TRACK.



STANDARD CLEARANCE

DRAWING NO 51.
N.T.S.

PASSENGER SHELTER ADJACENT TO TRAM TRACK



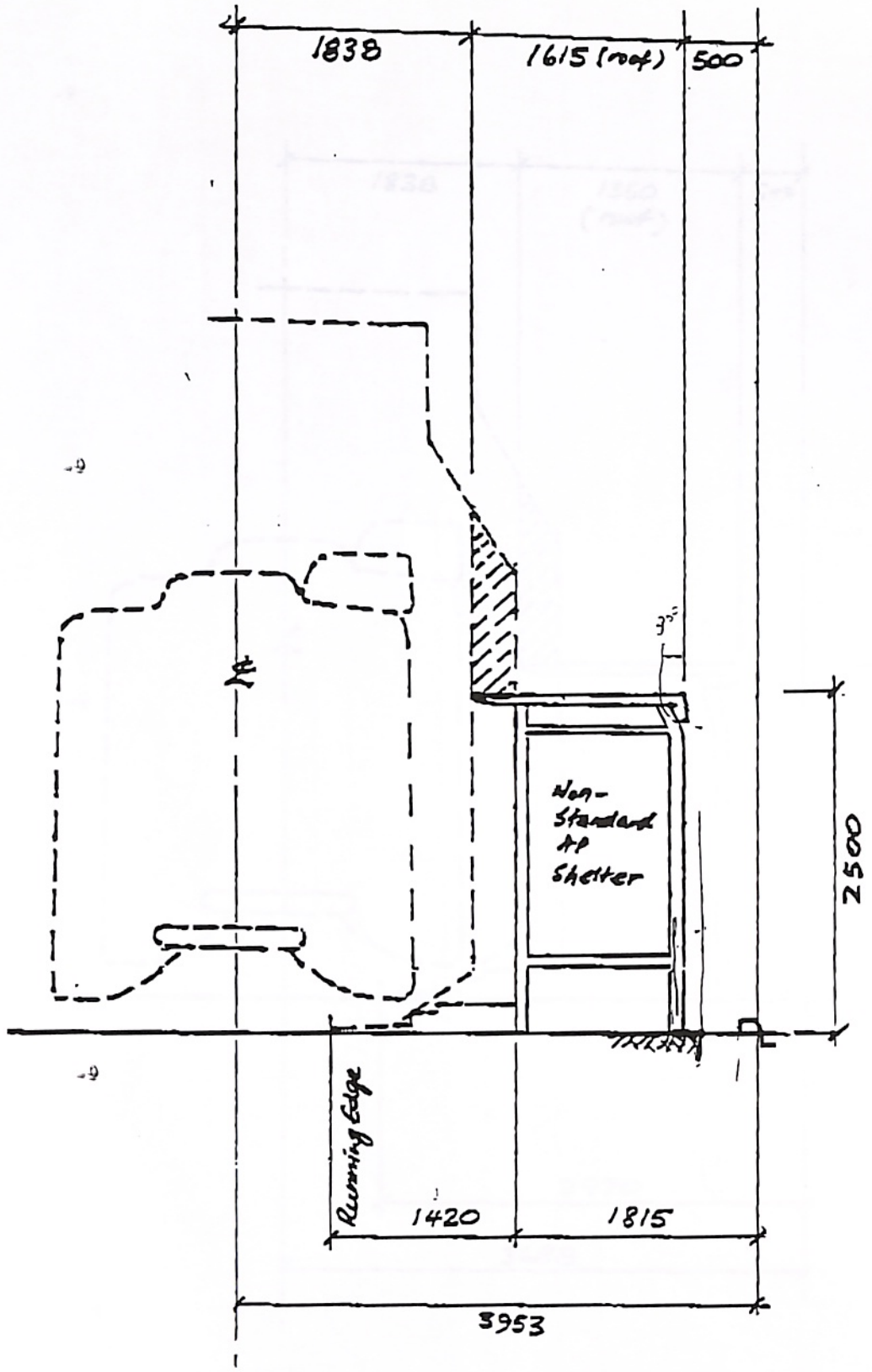
MINIMUM SHELTER (WITH STANDARD SHELTER)

DRAWING NO S2.

N.T.S.

MAUNSELL MELB

PASSENGER SHELTER ADJACENT TO TRAM TRACK

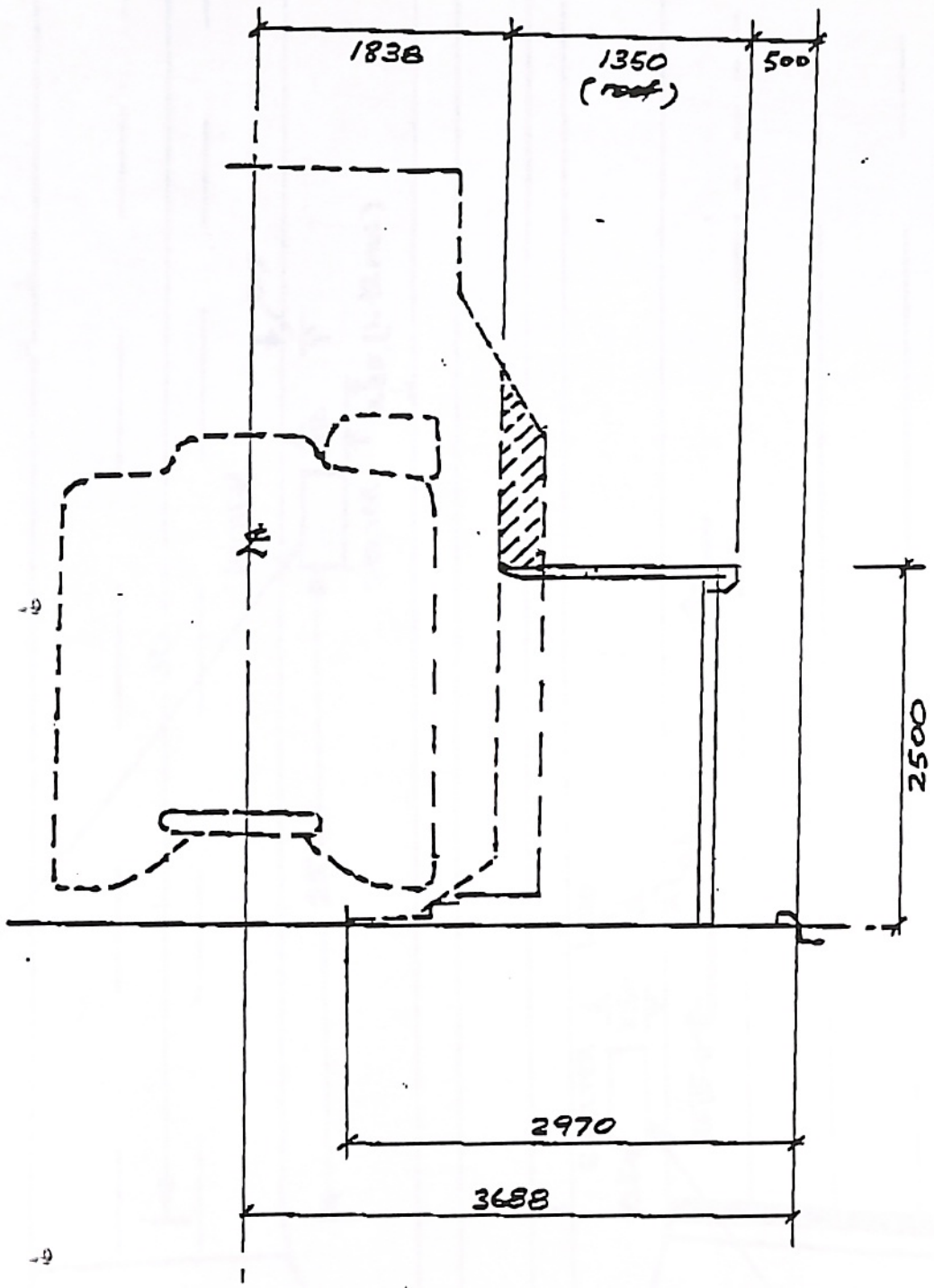


MINIMUM CLEARANCE (WITH ROOF CUT BACK)

DRAWING No S3

N.T.S.

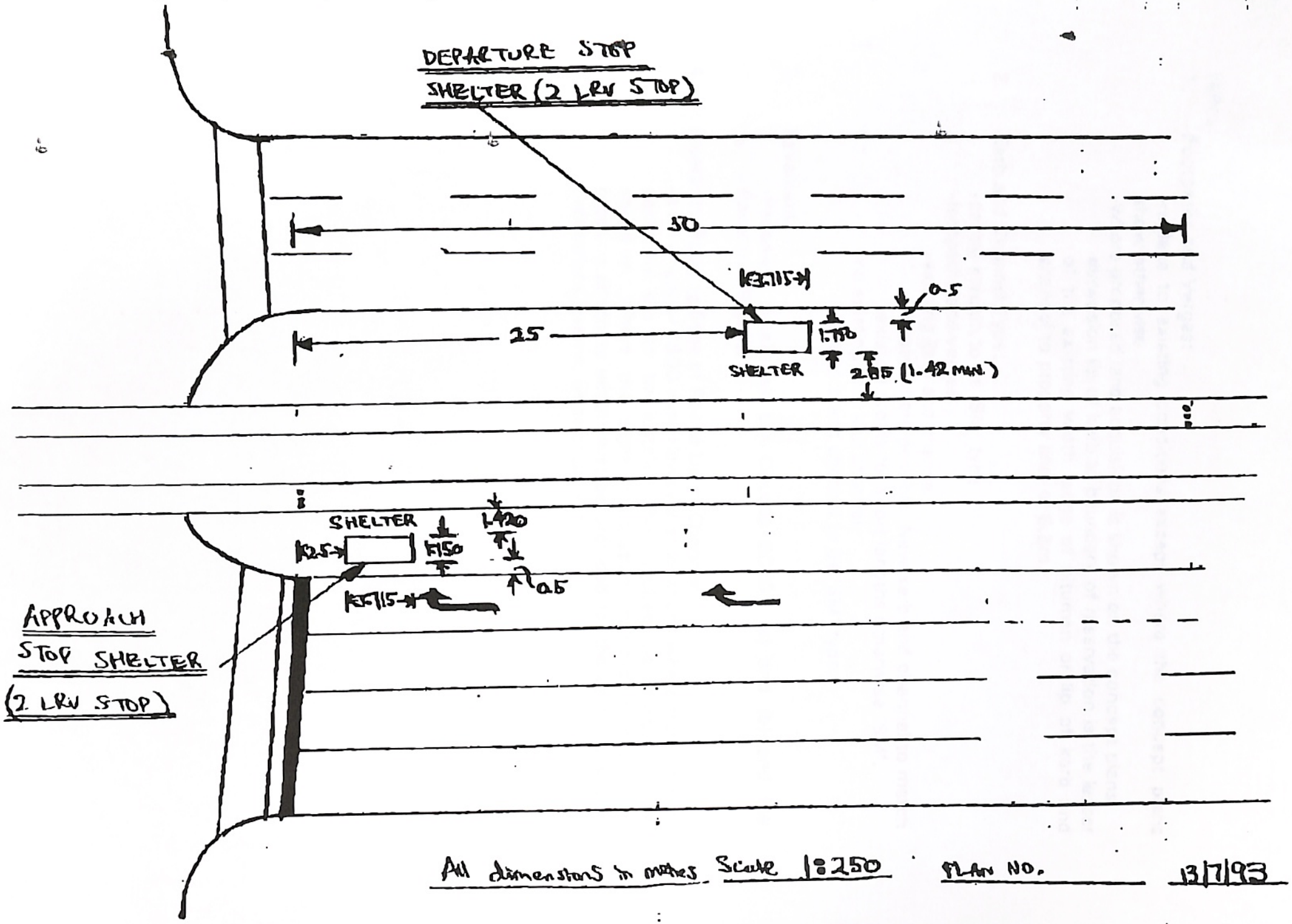
PASSENGER SHELTER ADJACENT TO TRAM TRACK



MINIMUM CLEARANCE (WITH MIN. WIDTH SHELTER WITHOUT SIDE WALL)

DRAWING NO S4.

N.T.S.



All dimensions in metres Scale 1:250 PLAN NO. 13/7/93

4.FEB.1998 11:38 MAUNSELL MELB 61 3 95547117 NO.632 P.23/24
MAUNSELL MELB

Notes:

1. Footpaths and Verges:
   - -replace to existing conditions except where the concept plans show otherwise
   - -where proposed land acquisition is shown on the concept plans dimension lip of kerb to boundary of reservation is the lesser of the existing width (edge of bitumen or lip of kerb and channel to property line) or 6.8m.

2. Kerb and Channel Type:
   - -centre median to be 'SM' type
   - -footpaths and verges
     - -existing kerb and channel
       retain where possible. New kerb and channel to match existing profile for short lengths otherwise 'SM'.
     - -no existing kerb and channel
       new kerb and channel to be 'SM' type.

3. Pavement:
   - -Pavement details as per Clauses SC201 (a) and (b) and the Pavement Report.

4. Clearance Running Edge of Rail to Lip of Channel:
   - -a minimum of 1800 mm. However at locations where traffic signal pedestals are to be installed the required clearances are as specified. Where the signal installation includes a pedestrian crossing adequate width must be provided for the safe storage of pedestrians, prams, wheelchairs etc.