TECHNICAL NOTE

INSTALLATION OF SMALL DIAMETER PIPE UNDER ROADS

Concrete Pipe and Precast
Association of Australasia

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AS/NZS 3725:2007 – Design for installation of buried concrete pipes outlines the minimum requirements for the installation of concrete pipes in Australia and New Zealand. It includes typical bedding and trench backfill requirements for installing concrete pipe, and outlines typical compaction levels that are necessary to ensure the requirements of the specified support type are met.

Unfortunately, too often the appropriate bedding techniques are not employed and the minimum compaction standards for bedding and backfill are not met. Whilst the Standard outlines the recommended minimum compaction levels for each support type, it does not provide guidance on test methods to check this on site. The outcome is that culverts using 225, 300, & 375mm diameter pipes become susceptible to circumferential cracking during construction.

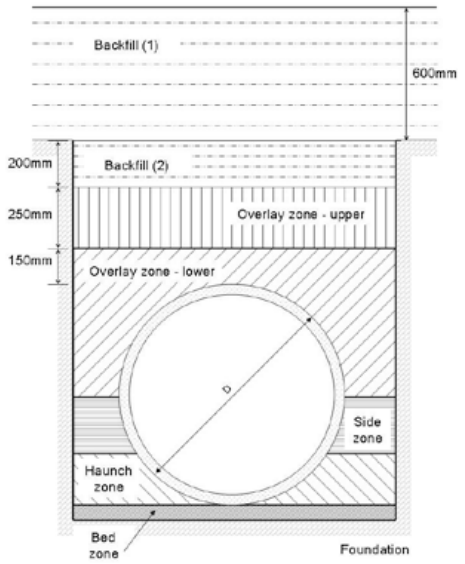

Figure 1: Modified HS2 bedding requirements as per AS/NZS3725

This **Technical Note** is designed to provide specifiers and contractors with a practical on site guide to assist achieving the required compaction levels outlined in AS/NZS3725 and to be able to verify them. An HS2 installation, as per **Figure 1**, has been assumed as this is a typical requirement for support under a roadway.

The minimum compaction requirements that must be achieved when installing to an HS2 support underneath a road are outlined in AS/NZS3725, and require the use of selected materials graded in accordance with Tables 6 & 7 of the Standard (see **Tables 1 & 2** below).

Using the **appropriate materials** that comply with the grading requirements of these tables will enable the required levels of compaction to be achieved without excessive **compaction efforts.** AS/NZS3725 notes under both these tables:

Acceptable material within the (tabled) grading limits would result in material that is well graded and free draining. Granular material that may exhibit these qualities but would break down when wetted, such as shale or gravely conglomerates, are not suitable materials and shall not be used.

SIEVE SIZE MM	WEIGHT PASSING %
19.0	100
2.36	100-50
0.60	90-20
0.30	60-10
0.15	25-0
0.075	10-0

Table 1: Grading limits for select fill in bed and haunch zone from AS/NZS3725 Table 6.

SIEVE SIZE MM	WEIGHT PASSING %
75.0	100
9.5	100-50
2.36	100-30
0.60	50-15
0.075	25-0

Table 2: Grading limits for select fill in side zone from AS/NZS3725 Table 7

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Tonkin and Taylor Ltd, in a CPPAA commissioned report, has provided practical information which is summarised in **Table 3** on the compaction testing of pipe support and foundation materials beneath road pavements. This table is a guide which should assist specifiers and contractors in the prevention of the problems which are generally associated with construction loading and trench settlement during pavement construction work using steel reinforced concrete pipe. The compaction and testing guidelines below are considered the minimum likely to produce compliance with the Standard.

ZONE	REQUIREMENT	HOW TO ACHIEVE	VERIFICATION/TESTING
Foundation	Uniform foundation support (refer to Note 1). Minimum CBR of 5% is recommended.	If CBR is not achieved undercut by 200 to 500 mm (refer to Note 4). Refill using material from Table 6 of AS/NZS3725 or AP20 material. Compact in 150 mm layers using an 80 kg plate compactor with a minimum of 3 to 4 passes.	Scala Penetrometer, minimum value of 1.5 blows/50mm, to achieve minimum CBR value of 5% refill compaction test by Clegg Hammer, minimum CIV of 8.
Bed	Compacted uniform bedding support, 100 mm minimum thickness. ID 60 as per Table 5, AS/NZS3725 (refer to Note 2). Bed must be prepared to ccommodate RRJ collars with appropriate clearance (refer to Note 3).	Using material from Table 6 of AS/NZS3725 compacted using an 80 kg plate compactor with a minimum of 3 to 4 passes.	Using Clegg Hammer, minimum CIV of 12 to 15 (refer to Note 5).
Haunch and Side	Haunch and side zone must extend to a minimum depth of 0.5D (minimum 150 mm wide each side). ID 60 as per Table 5, AS/NZS3725. Particular attention must be placed on compaction in these zones.	Using material from Table 6 of AS/NZS3725 compacted using a 15 to 20 kg hand rammer or "wacker" with a minimum of 20 to 30 blows on each side. Compact evenly on each side.	Using Clegg Hammer, minimum CIV of 12 to 15 (refer to Note 5).
Overlay (lower)	Lower overlay extends from top of side zone to 150 mm above the pipe. It is governed by requirements to protect the pipe from damage due to construction equipment.	Using material from Table 6 of AS/NZS3725 compacted using a hand rammer or "wacker" with a minimum of 20 to 30 blows on each side.	Using Clegg Hammer, minimum CIV of 10 to 12 (refer to Note 5).
Overlay (upper)	Upper overlay extends from 150 mm – 400 mm above the pipe. It is governed by requirements to protect the pipe from damage and to provide sufficient strength to support pavement layers above.	Using material from Table 6 of AS/NZS3725 compacted using an 80 kg plate compactor with a minimum of 4 to 5 passes.	Using Clegg Hammer, minimum CIV of 10 to 12 (refer to Note 5).
Backfill (2)	Backfill extending from 400 mm – 600 mm above pipe. It is governed by requirements to protect the pipe from damage and to provide sufficient strength to support pavement layers above.	Using GAP 20 or similar approved material compacted in maximum 150 mm layers using an 80kg plate compactor with a minimum of 6 to 8 passes.	Using Clegg Hammer, minimum CIV of 12 to 15 (refer to Note 5).
Backfill (1)	Backfill extending from 600 mm above pipe to the underside of the pavement. It is governed by requirements to protect the pipe from damage and to provide sufficient strength to support pavement layers above.	Using GAP 20 or similar approved material compacted in maximum 150 mm layers, standard compaction equipment may be utilised. Equivalent static axle load must not generate loads in excess of the pipe class rating. (Check using PipeClass software).	As per pavement requirements.

Table 3: Recommendations for small diameter concrete pipe to achieve HS2 compaction requirements

NOTES:

1. Uniform support must be achieved in the foundation and bed.
2. The bed zone requires a loosened band, width D/3, immediately under the centre line of the pipe to achieve the uniform support in the bedding required as per AS/NZS3725. Suggested methods to achieve this are:
   a. Rake and loosen D/3 zone no more than 25mm deep.
   b. Place 25mm thick loosely compacted even layer of material as per Table 6 AS/NZS3725.
3. Where RRJ pipes are used suitable recesses must be provided in the supporting materials to ensure pipes do not bear on their sockets.
4. Foundation undercut range stated is generally sufficient. Greater undercut may be required in particularly weak foundations.
5. Clegg Hammer values stated are subject to calibration testing for each material type/source against a true density from a testing method such as a Nuclear Densometer.

WARNING: Using material that does not comply with Table 6 AS/NZS3725 may result in a bed zone that does not meet the required uniform support levels.

Applying excessive compaction at a higher trench level in the hope that the desired compaction is achieved in the critical zones may not only fail to reach the required compaction but could also damage the pipe. This type of impact is the greatest cause of pipe cracking in Australia and New Zealand today. On this basis it is recommended that heavy vibratory rollers are only used once a minimum of 600mm cover has been achieved using material and compaction standards complying with the Standard.

Prevention is always the best cure. To ensure that your concrete pipe culvert requirements are not compromised, ensure that the appropriate installation techniques and testing requirements are included in specification to AS/NZS3725.