SECTION 765 - NOISE ATTENUATION WALLS

##This section cross-references Sections 160, 168, 175, 204, 610, 611, 630, 631, 685, 686, 715, 812 and V676.

If any of the above sections are relevant, they should be included in the specification.

If any of the above sections are not included in the specification, all references to those sections should be struck out, ensuring that the remaining text is still coherent:

765.01 DESCRIPTION

This section covers:

(a) The requirements for the supply of materials of noise attenuation walls (noise walls) panels which are manufactured from concrete, steel, composite, masonry or wood. It does not cover panels manufactured from plastic or gabions.

(b) The requirements for the erection of all noise walls.

In project-specific cases where noise walls are not required, this specification may be used for the supply of plywood panels for landscaping, fencing or aesthetic purposes (i.e. clause 765.05 is not required).

The supply of materials of noise walls using plastic panels, including those manufactured from recycled plastic must be in accordance with Section V676.

The supply and construction of gabions must be in accordance with Section 715.

The Department of Transport and Planning (DTP) was formerly known as the Department of Transport (DoT) and VicRoads. DTP documents that must be complied with include all relevant DoT and VicRoads documents.

765.02 REFERENCE

Documents referred to in this Standard Section are listed in Table 765.021. Section 175 details the relevant references to these documents.

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**Table 765.021: Referenced Documents**

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| Australian Standards, ISO & ATIC |
| AS/NZS 1163 | Cold-formed structural steel hollow sections |
| AS 1191 | Acoustics - Method for laboratory measurement of airborne sound transmission insulation of building elements |
| AS 1366.2 | Rigid cellular plastics sheets for thermal insulation - Rigid cellular polyisocyanurate (RC/PIR) |
| AS 1366.3 | Rigid cellular plastics sheets for thermal insulation - Rigid cellular polystyrene - Moulded (RC/PS - M) |
| AS 1530.8.1 | Methods for fire tests on building materials, components and structures - Tests on elements of construction for buildings exposed to simulated bushfire attack - Radiant heat and small flaming sources |
| AS/NZS 1604 (series)AS/NZS 1604.01AS/NZS 1604.02AS/NZS 1604.03 | Preservative-treated wood-based productsProducts and treatmentVerification requirementsTest methods |
| AS/NZS 2269 (series)AS/NZS 2269.0AS/NZS 2269.1AS/NZS 2269.2 | Plywood – StructuralSpecificationsDetermination of structural properties – Test methodsDetermination of structural properties - Evaluation methods |
| AS/NZS 2908.2 | Cellulose-cement products - Flat sheets |
| AS/NZS 3678 | Structural steel - Hot-rolled plates, floorplates and slabs |
| AS/NZS 3679 (series)AS/NZS 3679.1AS/NZS 3679.2 | Structural steelHot-rolled bars and sectionsWelded I sections |
| AS 3700 | Masonry Structures |
| AS/NZS 3750.15 | Paints for steel structures - Inorganic zinc silicate paint |
| AS/NZS 4455.1 | Masonry units, pavers, flags and segmental retaining wall units - Masonry units |
| AS/NZS 4680 | Hot-dip galvanized (zinc) coatings on fabricated ferrous articles |
| AS 5100.3 | Bridge Design - Bridge design Foundation and soil-supporting structures |
| ISO 10140-2 | Acoustics Laboratory measurement of sound insulation of building elements Part 2: Measurement of airborne sound insulation |
| AS ISO 11654 | Acoustics - Rating of sound absorption - Materials and systems |
| AS ISO/IEC 17025 | General requirements for the competence of testing and calibration laboratories |
| AS/NZS ISO 717-1 | Acoustics - Rating of sound insulation in buildings and of building elements - Airborne sound insulation |
| ATIC SP39 | Fasteners for Structural Purposes |
| ISO 9223 | Corrosion of metals and alloys — Corrosivity of atmospheres — Classification, determination and estimation |
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| BTN 007 | Noise Attenuation Walls |
| BTN 023 | AS5100 Part 3: Foundation and Soil-Supporting Structures |

765.03 GENERAL

(a) The structural design of the noise wall must be as described in Bridge Technical Note (BTN) 007 Noise Attenuation Walls.

(b) The following must be as shown on the drawings:

 1) type of noise wall;

 2) acoustic requirements;

 3) protective coatings;

 4) foundation details (including requirements for earthworks);

 5) alignment of the noise wall/s;

 6) cadastral / road edge and property boundary;

 7) existing and proposed infrastructure, drains, road safety barriers, signs, known utilities, fences and gates;

 8) topographic data (existing and proposed) over the area of interest including the road;

 9) height and length of noise wall, location of all footings and depths, geotechnical information of the alignment, supporting structures and the drainage requirements in longitudinal sections;

 10) the method of fixing the panel;

 11) the panel dimensions;

 12) panel material composition for noise wall and the minimum thickness;

 13) height and details of structures that interact with the noise wall in cross sections for each segment of the noise wall;

 14) design wind speeds; and

 15) noise performance indicators where applicable.

(c) Timber posts are not permitted be used.

(d) If an existing fence or noise wall is being replaced, existing timber posts must be removed.

(e) Openings in noise walls for inspection, maintenance and emergency access must be provided in the position and of the size and type shown on the drawings.

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(f) The design life of anchorages for noise attenuation walls, noise panels and their fasteners and fixings must be at a minimum:

 (i) anchorages on bridges, culverts and major retaining walls 100 years

 (ii) anchorages on other applications 50 years

 (iii) posts and other structural components 50 years

 (iv) panels, panel fixings and fasteners 30 years

The design life for any components of noise walls that form a structural part of other structures, must comply with the requirements for the particular structure.

(g) If the construction of the noise wall requires access over or work adjacent to a landscaped area, the Contractor must take steps to minimise damage to vegetation. The Contractor must submit to the Superintendent a methodology for avoiding damage to vegetation a minimum of seven days prior to work commencing.

(h) If a noise wall is located on or adjacent to a private property boundary, the Contractor must ensure that there is no damage to private property including gardens, vegetation and garden furniture. Any damage to private property must be repaired by the Contractor to the satisfaction of the Superintendent.

(i) All required testing must be conducted at a National Association of Testing Authorities (NATA) accredited laboratory. In the absence of a NATA-approved laboratory, testing must be conducted by a laboratory approved by DTP for this purpose. The testing methodology must be approved by DTP before testing commences.

 The Contractor must supply test certificates that demonstrate compliance with the specified requirements. All test reports/certificates must be endorsed in accordance with the AS ISO/IEC 17025 accreditation for that laboratory. If requested by the Superintendent, the Contractor must submit documents that allow materials to be traced to their point of origin.

 Refer to Section 160 for further details.

(j) The Contractor must ensure any trees that are required to be planted as part of the Contract are formatively pruned directing plant growth to prevent lateral branches impacting the noise wall.

765.04 NOISE WALL MATERIALS

All materials must be stable when exposed to Ultra-Violet (UV) radiation over the design life, which must be warranted by the supplier. All materials must be stable when exposed to water, wind, air pollutants and temperature change.

All materials must be supplied by the Contractor and must comply with the following:

(a) Steel for Posts and Panels

 All steel must be:

 (i) compliant with AS/NZS 3679

 (ii) compliant with AS/NZS 1163

 (iii) the grade specified on the drawings

 (iv) supplied and fabricated in accordance with Section 630

 (v) galvanised in accordance with:

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 • AS/NZS 4680

 • Section 631

 On completion of galvanising, components must receive decorative coatings and finishes as specified on the drawings and/or in the landscape architectural design brief.

 Galvanised components that have been damaged or cut must be repaired with a minimum of two coats of inorganic zinc-rich paint in accordance with AS/NZS 3750.15, AS/NZS 4680 and Section 631.

 After repair of the galvanising, damaged paint coatings must be repaired in accordance with Section 631.

 Steel plates must comply with the requirements of AS/NZS 3678 and must be a minimum of Grade 300.

 Steel hot rolled sections must comply with the requirements of AS/NZS 3679.1 and must be a minimum of Grade 300.

 Steel hollow sections must comply with the requirements of AS/NZS 1163 and must be a minimum of Grade 350.

(b) Concrete for Foundations

 The minimum grade of concrete for foundations must be grade VR330/32 in accordance with Section 610.

 The concrete foundations must meet the requirements of AS 5100.3, BTN 023 and Section 610.

(c) Concrete for Panels

 Concrete panels must have sufficient strength to resist the loads to which they will be subjected including the self-weight of other panels and the imposed loads due to earth pressure and other load-effects due to thermal expansion, handling and accidental impact.

 The minimum grade of concrete for panels must be grade VR330/32 in accordance with Section 610.

(d) Composite Panels

 Composite panels are defined as panels having a low density and thick core bonded between two relatively thin, hard, strong and rigid faces.

 Facing material must be fibre reinforced cement flat sheet conforming to the requirements of AS/NZS 2908.2.

 Core material must be either rigid cellular polyisocyanurate (RC/PIR) conforming to the requirements of AS 1366.2 and having a minimum density of 30 kg/m2, or rigid cellular expanded polystyrene (EPS) conforming to the requirements of AS 1366.3 and having a minimum density of 11 kg/m2.

 Adhesive material must be phenolic or similar material type that maintains its adhesive properties and structural performance when exposed to UV light, wet or damp conditions without glue line breakdown or glue line failure for the panel’s design life.

 The bond between the face and core must cover the whole area of the sheet.

 Edge capping (e.g. aluminum, steel) suitably protected against corrosion, must be attached to all edges of the noise walls.

 Composite panels must not be cut or modified except as required at specified points for fitting or joining. Where a composite panel is cut on-site, a suitable remedial treatment of the finish must be applied as per the manufacturer’s requirements.

(e) Plywood Panels

 Plywood panels must be:

 (i) compliant with the requirements of AS/NZS 2269 including those for shape, dimensional, branding, etc.

 (ii) made with structural plywood of the stress grade described on the drawings but not less than stress grade F14

 (iii) made with B‑quality softwood face and back veneers

 (iv) free of spurs and splinters

 (v) consistent in texture and appearance

 (vi) of minimum density 18 kg/m²

(f) Preservative Treatments of Panels

 Copper chromium arsenic (CCA) preservatives must not be used.

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 (i) Preservative treatments for panels must be:

 • either veneer treatment or envelope treatment compliant with AS/NZS 1604

 • applied before construction

 • applied to areas of timber revealed by cross cuts such as holes, notches and rebates in accordance with the manufacturer’s recommendations.

 (ii) The plywood panels in contact with the ground must be treated to a minimum hazard class H4 as specified in AS/NZS 1604.1.

 The plywood panels not in contact with the ground are to be treated to a minimum hazard class H3 as specified in AS/NZS 1604.1.

 (iii) Veneer treatment must be compatible with the specified stain finish.

 (iv) Panels must be re‑dried or air-dried to a moisture content of less than 18 per cent after preservative treatment to ensure dimensional stability prior to erection.

 Treated timber must not be re-sawn, dressed, planed or modified except as required at specified points for fitting or joining. Where on site cutting is required, if an envelope-treated plywood panel is cut 20 mm or more from an edge of a sheet, a suitable remedial treatment to repair the envelope must be applied to cut surfaces as per the manufacturer’s requirements. The applied product must be completely dry before incorporation of the panel into the noise walls. Alternatively, the cut plywood must be retreated in accordance with AS/NZS 1604.1.

**HP The Contractor must submit to the Superintendent preservation and grading certificates from the treatment plant showing chemical retention, penetration of the preservation and compliance with the requirements of AS/NZS 1604 before delivery of material to the site commences. Methods of analysis and testing of the material must comply with the Australian Standard. Where an envelope-treated plywood panel is required to be cut at a specified point, the Contractor must submit the proposed remedial treatment to the Superintendent.**

(g) Fire Resistance

 Unless a more detailed bushfire risk analysis has been carried out and approved by DTP, all noise wall panels (except plywood panels) must be designed to a minimum BAL 12.5 and tested in accordance with AS 1530.8.1, with modifications as follows:

 (i) For panels larger than 1 m x 1 m, a test specimen with minimum dimensions of 1 m x 1 m must be used.

 (ii) For panels with any dimension smaller than 1 m, a test specimen of the largest dimensions available must be used.

 (iii) The test specimen must be supported in a vertical configuration.

 (iv) Crib type Class A must be used.

 (v) The crib must be placed adjacent to and touching the test specimen.

 (vi) Flames must not spread to the extent of the tested specimen.

 Plywood panels without fire retardant must not be used in areas with High Fire Risk Rating in the Road Bushfire Risk Mapping (refer to Bushfire Risk Assessment Guidelines and Road Bushfire Risk Assessment Guideline and Risk Mapping Methodology for further details). Plywood panels with fire retardant used in areas with High Fire Risk Rating must meet a minimum BAL 12.5 and be tested in accordance with AS 1530.8.1 and modifications as above. Materials for fire retardants applied on plywood must be water-based and non-toxic. Fire retardants must be applied to all components when required.

 Noise walls must not emit any noxious fumes or leachates in environmentally dangerous concentrations when burned.

 (h) Fittings and Fastenings

 (i) Panels must not be drilled for mounting purposes.

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 (ii) Panels must be mounted in metal channels fixed to the posts which must include rubber or similar gaskets to grip the panels but have sufficient freedom to allow their norm al range of thermal expansion and contraction without damage to the panel or posts.

 (iii) Panels must be readily replaceable (i.e. the supply of the panels is available in the market).

 (iv) Channels must be galvanised in accordance with the AS/NZS 4680.

 (v) All fittings and fasteners must have a 30‑year design life and must be suitable for external use in moderate industrial or marine environments (corrosivity categories C2 and C3 classified in accordance with ISO 9223).

 (vi) The use of self-tapping, self-locking, self-loading or thread-rolling fasteners or any similar products is not permitted. Fasteners must comprise a threaded bolt, nut, flat and spring washers in a pre-drilled clearance hole.

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 (vii) Fasteners for connections between channels and structural members must be of Grade 316 stainless steel that complies with ATIC‑SP39 Fasteners for Structural Purposes.

(i) Coatings

 Anti-graffiti coatings must comply with Section 685 and the following requirements:

 (i) clear-film type sacrificial anti-graffiti coatings must not be used

 (ii) liquid sacrificial anti-graffiti coatings are permitted provided that the coating is soluble in warm water

 (iii) coating must be clear

 (iv) coating must be applied to the extent described on the drawings or in the specification.

 Decorative coatings must be as shown on the drawings and/or the architectural design brief and must comply with Section 686 and must be applied in accordance with the manufacturer’s recommendations.

 In addition to the directions and application rate recommended by the manufacturer:

 • prior to applying the stain, the panels must be clean, free of dust, and free of dirt

 • the designated colours for both front and rear panels must be stained over the full width and height of the panel, including the edges

 • the first coat must be an undiluted full and generous flood-coat

 • a minimum 24 hours drying time must be allowed following the application of the first coat prior to application of the second coat or in accordance with the manufacturer’s recommendation.

**HP The Contractor must submit colour samples and proposed arrangement to the Superintendent for approval not less than two weeks prior to application to the noise walls. These samples must be applied to the specified noise wall panel material and must be a minimum of one square metre. Each sample must show all separate stages of coating.**

(j) Masonry

 Design of masonry components must be in accordance with AS 3700.

 Masonry block material must be either burned clay, plain concrete or autoclaved aerated concrete in accordance with AS/NZS 4455.1.

 Concrete and reinforcement must comply with Sections 610 and 611.

 Articulation / control joints must be incorporated in all masonry walls at a maximum 6 m spacing.

(k) Other Materials

 Materials other than those described above may be permitted as follows:

**HP If the Contractor proposes the use of alternative materials for posts and panels, full details of the strength, durability, acoustic properties, appearance and other physical properties of the proposed material must be submitted to the Superintendent for approval not less than 12 weeks prior to the intended use of the material.**

 **The Contractor must supply all test certificates that demonstrate compliance with the specified requirements, in accordance with clause 765.03(i) and Section 160.**

765.05 ACOUSTIC DESIGN - MATERIALS

(a) The panels must be constructed of reflective and/or absorptive type material. Panels must have sufficient intrinsic airborne sound insulation performance to ensure that, for all receivers, the sound transmitted directly through the noise wall must not be less than 10 dB below the sound diffracted at the top of the noise wall.

 The following is deemed to satisfy these requirements:

 (i) non-porous construction with no gaps and a surface density of at least 20 kg/m2 at its thinnest point; or

 (ii) construction that has a sound insulation rating value of the weighted sound reduction index with spectrum adaptation term Rw + Ctr of at least 25dB when determined in accordance with AS/NZS ISO 717-1.

 The laboratory measurements of airborne sound insulation must be conducted in accordance with AS 1191 or ISO 10140-2, with the test specimen mounted and assembled in the same manner as the manufactured device is used in practice. The side that would face the traffic must face the source room. Where posts are employed in construction, at least one post must be included in the specimen, with panels attached on both sides and the length of the panel on one side of the post must be ≥ 2 m.

(b) In addition to the minimum Rw requirements in clause 765.05(a), the following applies to absorptive noise walls:

 (i) the Weighted Sound Absorption Coefficient (αw) of the noise wall panels must not be less than 0.8 measured in accordance with AS ISO 11654;

 (ii) the absorptive face must be on the traffic side; and

 (iii) absorption is not required in the noise wall between 0 mm and 500 mm above the ground.

 The sound absorption measurements must be conducted with the test specimen mounted and assembled in the same manner as the manufactured device that is used in practice with the same connections and seals between component parts. The test specimen must be placed directly against one of the test chamber surfaces (floor, wall or ceiling) without gaps as far as possible. If posts are employed in construction, at least one post must be included in the specimen with panels attached on both sides. The length of the panels on one side of the post must be ≥ 2 m. The side that would face the traffic must face the inner part of the test chamber.

 The acoustic properties of sound absorptive materials must not diminish over the design life of the noise wall.

(c) The acoustic properties of the panel must be retested if a substantial change is made to the design of the panel, which includes a variation to the wall thickness and front face shape.

(d) Noise walls must have no holes or gaps except where the noise walls overlap.

765.06 CONSTRUCTION AND INSTALLATION OF NOISE WALLS

(a) General

 Noise wall must be manufactured and installed in accordance with the drawings and this specification.

 Noise walls must be free of holes or gaps. The formation of gaps or holes at the lower edges of noise walls will lead to the passage of noise under the wall.

 Prior to any site modification of a panel, the approval of the designer must be obtained and a copy of that approval submitted to the Superintendent.

 The Contractor must ensure that the manufacturer designs for weathering during storage.

 (b) Set Out of Noise Wall

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 Noise walls must be located in accordance with the drawings.

**HP If the Contractor proposes an alternative alignment, details of the alternative must be submitted to the Superintendent for approval not less than four weeks prior to commencement of works.**

(c) Post Holes

**HP Prior to boring post holes the Contractor must review their location with the Superintendent. The Contractor must seek the Superintendent’s approval of any proposed relocations.**

 Post holes must be in the locations shown on the drawings.

 Post holes must be covered until the post has been installed.

 Unsuitable or excess excavated material must be removed from site on completion of the works.

(d) Foundations

 The size, type and depth of foundations and design loads must be as shown on the drawings.

 Excavation for foundations must be as shown on the drawings and must comply with Section 204.

 Excavation for noise wall foundations must include all excavation necessary to provide the specified depth of bedding, working space and space required for filling, including the removal and replacement of unsuitable material. The foundations must be firm, hard and dry meeting the minimum bearing capacity specified in the Design.

 Soft or wet material that does not achieve the required ground bearing pressure stated on the drawings or does not pass the test rolling must be treated as unsuitable material. Unsuitable material must be excavated and replaced with 40 mm Class 3 crushed rock or cement treated crushed rock compacted in layers not exceeding 150 mm to achieve the required ground bearing pressure stated on the drawings. Replacement material must comply with the requirements of Section 812.

 If the foundation is in rock, all loose rock, unsound material or water must be removed and the surface must be brought to the required level with blinding concrete.

**HP Prior to the placement of reinforcement and posts, the Contractor must review the excavation for compliance with the specified requirements and must inform the Superintendent of any unsuitable soil conditions.**

 Cast-in-place concrete surrounding foundation posts must be brought to a level surface 50 mm above the finished surface level and must then be tapered for a minimum distance of 300 mm from the base of the post to ensure that water drains away from the foundation.

(e) Installation of Posts

 Posts must be straight and vertical with a tolerance of 1 in 100 of the height of the post.

 Where the design requires non‑vertical or curved posts these must be erected to the required angle or profile from the control point with a tolerance of 1 in 100 of the height of the post.

 Tops of adjacent posts must be level or to the grade line on the drawings with a tolerance of ± 10 mm.

(f) Installation of Panels

 Panels dimensions must be to the sizes shown on the drawings with a tolerance of ± 5 mm in each dimension.

 Adjacent panels of stepped or sloping walls must be stepped equally to meet the alignment of the wall or as shown on the drawings.

 Panels and planks must be either horizontal or sloping as required on the drawings with a tolerance of ± 5 mm in 3 m.

 If the specified span for the panel cannot be achieved the Contractor must submit details of the alternative panel length to the Superintendent for approval.

**HP The Contractor must submit details of alternative panel lengths to the Superintendent not less than two weeks prior to commencing the fabrication of that section of the noise wall.**

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 The lowest plank, panel or units of a concrete noise wall must be continuously supported by a plain concrete rectangular spread foundation with a minimum width of the panel thickness plus 200 mm on either side of the panel, and a minimum depth of 150 mm. The spread foundation must be symmetrical about the centre of the panel unless the noise wall is on a boundary in which case the position of the spread foundation must be adjusted.

 The minimum grade of concrete for strip foundation must be grade VR330/32, placed and compacted in accordance Section 610.

 Top-soil must be removed from the plan area of the strip foundation. The excavation for the spread foundation must be treated in accordance with clause 765.06(d).

 Concrete maintenance strips must be provided in accordance with BTN 007.

(g) Installation of Transparent Panels

 Transparent panels must be installed in accordance with the following requirements:

 (i) all panels must be supplied with masking film or protective sheets on both surfaces which must not be removed until handling and installation of the panel are complete

 (ii) care must be taken during the installation of panels to prevent cracking, scratching or damage

 (iii) panels that are cracked, scratched or damaged must be replaced

 (iv) panels must be restrained as detailed by the drawings.

(h) Doors/Gates and Openings

 The Contractor must install doors of the type and in the position shown on the drawings.

 Openings and doors must be framed with a suitably rigid frame which must be made from the same materials as the noise wall panels and of the same colouration.

 Where the openings are designed, a permanent chain wire mesh fence in accordance with DTP SD 3131B (or equivalent) must be provided to avoid the public access through the openings. The fencing must include a lockable door/gate capable of allowing access for maintenance.

 Doors must be hung securely and fitted with a locking mechanism that can be operated from either side of the noise wall. All locks must be Lockwood – Assa Abloy (334 Padlock Series) which will be supplied by the Superintendent.

 **The Contractor must give the Superintendent a minimum of four weeks’ notice of the need for locks.**

 Gaps at openings for doors must be sealed to ensure minimal noise transmission.

**HP The Contractor must submit details of the door and frame design to the Superintendent not less than two weeks prior to commencing the fabrication of that section of the noise wall.**

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765.07 TEMPORARY FENCING

During construction, the Contractor must provide temporary mesh fencing with a minimum height of 1.8 m which must be covered with shade cloth to secure and screen any private properties and to prevent access to the road reserve and/or private properties by animals, people or vehicles.

765.08 SAFETY

Noise walls must be erected in a safe manner and in accordance with Section 168 (Occupational Health & Safety) and the requirements of the Occupational Health and Safety Act 2004 and the accompanying Regulations.

Subject to suitable risk assessments and hazard identification the Contractor must:

(a) employ suitable mechanical lifting devices to erect posts and panels. Mechanical lifting devices must be stable, sited in a suitable location and must be operated by experienced personnel;

(b) provide temporary supporting structures to ensure stability of the noise wall during erection and assembly;

(c) provide temporary access in the form of mechanical platforms and/or scaffolds if it is necessary to work at height.

765.09 DISPOSAL OF MATERIALS

On completion of the project, the Contractor must remove all surplus excavated and fill material, unsuitable materials and noise wall materials from the site. The site must be left in a clean and tidy condition free from contamination.

765.10 DAMAGE TO NOISE WALL COMPONENTS

The Contractor must ensure all components are handled with care to avoid breakage, scratches and other damage. Damaged components must be replaced at the Contractor’s expense to the satisfaction of the Superintendent.

765.11 MAINTENANCE

The Quality Plan must include a Maintenance Manual which specifies the maintenance requirements and procedures for the noise wall, including:

a) procedure for removing graffiti;

b) recommendations for painting or other maintenance measures;

c) procedure for replacement in the event of fire damage a panel;

d) procedures for repair or replacement in the event of other damage to a panel; and

e) procedures for maintenance of access doors/gates.

765.12 WARRANTY

The panels must be supplied with a Manufacturer’s warranty for minimum period of 15 years in the name of the Asset Owner. The warranty must:

a) cover defective design, material, manufacturing, replacement of defective components and all costs associated with the replacement of defective components.

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