# Afon Wen MPH

DJP 127m 61ch

## Sheet pile wall and scour protection

## NR/L2/CIV/003/FormG: Combined Certificate of Approval in Principle, Design and Check for Design Check Category I Permanent works

## Revision History

| Edition | Description | Prepared | | Checked | | Approved | |
|---|---|---|---|---|---|---|---|
| | | By | Date | By | Date | By | Date |
| A01 | First Issue | WE | 03/07/2023 | VF | 03/07/2023 | DB | 03/07/2023 |
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## Document: 23162B-FOG-001-A01 Afon Wen MPH Form G

| Project Title | Afon Wen MPH | |
|---|---|---|
| Project Nr | 23162B | |
| Remit / Technical Work Scope (TWS) Nr | Sheet pile wall and scour protection | |
| Requirements documents reference Nr | N/A | |
| CR-T reference Nr | N/A | |
| Other design and check certificates associated with this submission | N/A | |

# PART 1: DETAILS

## 1.1 Proposed Works and Scope of Design

| Description | Sheet pile wall and rock armour scour protection | | |
|---|---|---|---|
| Location | Afon Wen | | |
| ELR | DJP | Mileage | 127m 61ch |
| Asset Nr | N/A | OS grid ref | SH 44803 37183 |
| Permanent Works | Yes | Design Check Category | CAT1 |

The existing sea wall coastal defence at Afon Wen has been identified by Network Rail for renewal. Following inspections in 2014 and 2018, sections of the defence were found to be in poor condition, attributed to by wave action, weather conditions and coastal processes.

The existing coastal defence comprises a stone mortared wall, fronted by a concrete apron with a sheet pile toe. The design in this Form G pertains to a particular section of the sheet pile wall approximately 15.0 m in length. The sheet piles along this section have been expelled or have experienced lateral movement past the serviceability limit state, as such require replacement. The location of the defective sheet pile section is shown in Figure 1.

Renewal works are to comprise replacement of sheet piles, grouting of voids behind and placement of new rock armour at the toe.


Figure 1: Site location

## 1.2 Design Criteria and design Statement

### 1.2.1 General

Ultimate Limit State (ULS) analysis for the retaining wall has been undertaken in accordance with BS EN 1997-1. Design Approach 1 is undertaken, and the partial factors applied are Combination 1 and Combination 2 for limit state GEO are applied

Serviceability Limit State (SLS) analysis is also undertaken in accordance with BS EN-1997-1, with partial factors equal to unity.

The software GEO5 Sheeting Check and GEO5 Sheeting Design are used for the analyses, which undertake a limit equilibrium analysis and displacement analysis. The software also performs structural checks for bending and shear for the selected pile, in accordance with BS EN 1993-5:2007 5.2.2.

### 1.2.2 Geotechnical Design and considerations

This section forms the Geotechnical Design Report (GDR), in line with NR/L3/CIV/071. All proposed design work is expected to be classed as Geotechnical Category 2 as per with BS EN 1997-1:2004. The selection of this category is on the basis that the scheme includes conventional types of structures or foundations with no exceptional risk, difficult ground conditions or loading conditions.

## Ground Investigation

A ground investigation (GI) was undertaken for the entire Afon Wen sea defence as part of the Coastal, Estuarine and River Defence (CERD) scheme. The GI was undertaken by Geotechnical Engineering Limited in February 2023. The works comprised window sample boreholes and adjacent dynamic probe testing. WS004 and DP004 were undertaken on the beach in front of the sheet pile section and therefore are used to derive the ground model and geotechnical parameters for this design.

## Ground model and test results

The geological stratigraphy and test results are given in Table 1. Figure 2 shows the equivalent SPT N plotted against depth.

**Table 1: Ground model and test results**

| Stratum | Typical description | Top depth (m bgl) | Thickness (m) | Typical SPT N | BRE SD 1 |
|---|---|---|---|---|---|
| Loose beach deposits | Loose silty fine SAND with extremely closely spaced thin laminae of clay. | 0.0 | 6.0 | 3 - 12 | DS-1, AC-1 |
| Medium dense beach deposits | Medium dense becoming dense clayey fine and medium SAND. | 6.0 | > 4.0 | 17 - 47 | No testing |

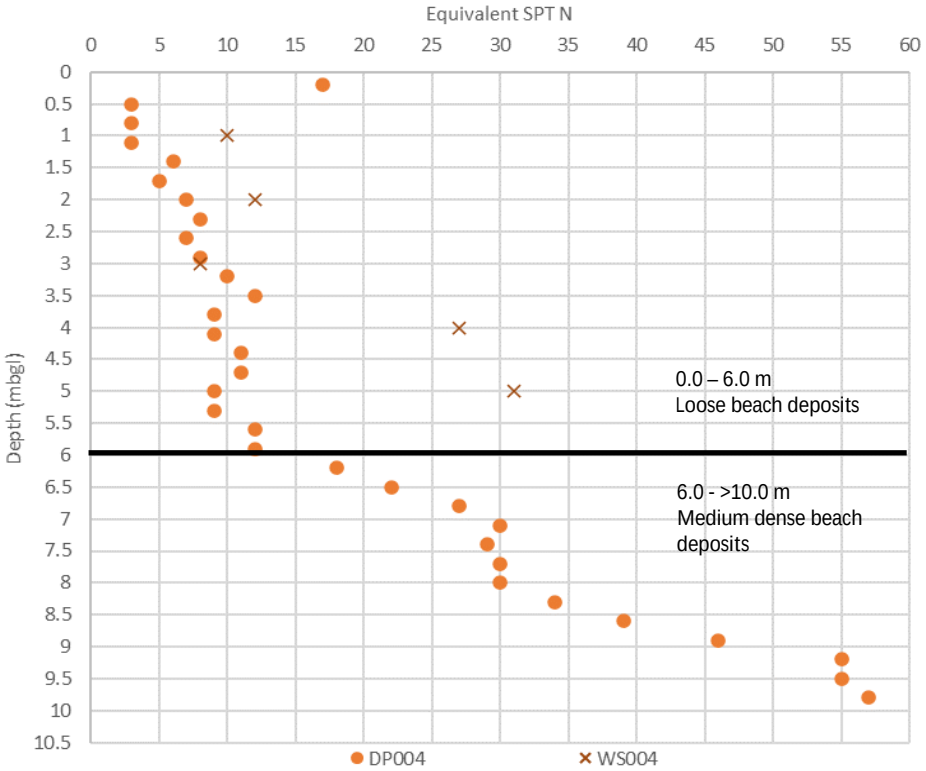



**Figure 2: SPT N value vs depth**

## Characteristic geotechnical parameters

The table below provides the characteristic geotechnical parameters for the materials. These are based on test results, published correlations and engineering judgement.

**Table 2: Characteristic geotechnical parameters**

| Stratum | Bulk unit weight, $\gamma$ (kN/m$^3$)(1) | Saturated unit weight, $\gamma_{sat}$ (kN/m$^3$)(2) | Effective peak angle of friction, $\varphi'_{pk,k}$ (°) (3) | Effective cohesion, $c'_{pk,k}$ (kN/m$^2$) | Poisson's Ratio(4) | Effective Young's Modulus, E' (MN/m$^2$)(5) |
|---|---|---|---|---|---|---|
| Loose beach deposits | 16 | 18 | 30 | 0 | 0.35 | 5 |
| Medium dense beach deposits | 17 | 19 | 32 | 0 | 0.35 | 30 |

Notes
(1) BS 8002:2015 Figure 1
(2) BS 8002:2015 Figure 2
(3) CIRIA 143 Figure 36a
(4) Engineering judgement
(5) CIRIA 143 E' = $N_{60}$

## Design considerations and assumptions

- The soil to wall interface friction coefficient is taken as 2/3 $\varphi'_{cv,k}$ as per BS EN 1997-1:2004 for steel sheet piles. It is assumed the wall friction will be fully mobilised.
- Passive resistance provided by the rock armour in front of the wall is ignored in the analysis.
- Concrete backfill will be poured in layers up to 0.5 m thick. Trapezoidal loads are applied in the SLS analysis to simulate loading of wet concrete during construction.
- The concrete is modelled as cured in the ULS limit equilibrium analysis.
- In the ULS analysis, the height of the wall is modelled as 1.65 m, which accounts for a 10 % increase in wall height as per BS EN 1997-1:2004.
- A 5.0 kPa pedestrian surcharge is applied.
- In ULS, groundwater is modelled at the beach level in front of the wall, and at the top of the crest behind the wall. This is to simulate the scenario where tidal water drains from behind the wall slower than the tide recedes.
- For structural capacity checks in the ULS analysis, a thickness loss of 9.0 mm over 120 years due to corrosion is applied in accordance with BS EN 1993-5:2007 Table 4-2, for steel in low water and splash zones.

## Analysis results

The results presented in Table 3 show that the proposed 6.0 m long pile design satisfies the ULS limit equilibrium and SLS displacement requirements of BS EN 1997-1:2004. The maximum allowable lateral displacement is taken as L/200 (30 mm). Structural checks for bending resistance, section modulus, shear resistance and buckling have been undertaken as per BS EN 1993-5:2007 5.2.2. The proposed sheet pile (GU 28N) satisfies the checks for the 120-year design life.

**Table 3: Analysis results**

| Retained height (m) | Embedded length (m)(1) | Limit state | Max. bending moment (kN.m) | Max. shear force (kN) | Displacement (mm) | Min. required structure length (m) (2) |
|---|---|---|---|---|---|---|
| 1.50 | 4.50 | SLS | 6.85 | 23.64 | 11.8 | 3.78 |
| 1.65 | 4.35 | ULS C1 | 11.80 | 34.07 | N/A | 4.94 |
| 1.65 | 4.35 | ULS C2 | 14.53 | 34.34 | N/A | 5.51 |

Notes
(1) Proposed sheet pile length is 6.0 m.
(2) Minimum required length of sheet pile (retained + embedded) for Factor of Safety of 1.0.

### 1.2.3 Design Criteria

**Design Life**

Design life of structure is 120 years.

**Operational requirements**

Scour protection.

**Loading requirements**

5.0 kPa pedestrian loading.

**Environmental requirements**

Appropriate environmental and ecological licences and permissions to be in place for working in a marine environment.

## 1.3 Standards used in the Design

### 1.3.1 Date of standards freeze

June 2023.

### 1.3.2 List of Design standards

**Eurocodes**

| *Reference* | *Title* |
|---|---|
| *BS EN 1990: 2002+A1:2005* | *Basis of Structural Design* |
| ~~*BS EN 1991-1-1:2002*~~ | ~~*Actions on structures. General actions – Densities, self-weight and imposed loads for buildings*~~ |
| ~~*BS EN 1991-1-2: 2002*~~ | ~~*Actions on Structures. General Actions. Actions on Structures Exposed to Fire.*~~ |

| *Reference* | *Title* |
|---|---|
| ~~*BS EN 1991-1-3:2003+A1: 2015*~~ | ~~*Actions on structures. General actions – Snow loads*~~ |
| ~~*BS EN 1991-1-4:2005 + A1: 2010*~~ | ~~*Actions on structures. General actions – Wind actions*~~ |
| ~~*BS EN 1991-1-5: 2003*~~ | ~~*Actions on structures. General actions – Thermal Actions*~~ |
| ~~*BS EN 1991-1-6: 2005*~~ | ~~*Actions on structures. General Actions – Actions During Execution*~~ |
| ~~*BS EN 1991-1-7:2006 + A1: 2014*~~ | ~~*Actions on structures. General actions - Accidental actions*~~ |
| ~~*BS EN 1991-2: 2003*~~ | ~~*Actions on structures. Traffic loads on bridges.*~~ |
| ~~*BS EN 1991-3 2006*~~ | ~~*Actions on Structures. Actions induced by cranes and machinery*~~ |
| ~~*BS EN 1991-4 2006*~~ | ~~*Actions on Structures. Silos and Tanks*~~ |
| ~~*BS EN 1992-1-1: 2004 + A1: 2014*~~ | ~~*Design of concrete structures. General rules and rules for buildings.*~~ |
| ~~*BS EN 1992-1-2: 2004*~~ | ~~*Design of concrete structures. General rules – structural fire design*~~ |
| ~~*BS EN 1992-2-2005*~~ | ~~*Design of concrete structures. Concrete Bridges. Design and detailing rules*~~ |
| ~~*BS EN 1992-3-2006*~~ | ~~*Design of concrete structures. - Liquid retaining and containment structures*~~ |
| *BS EN 1993-1-1:2005 +A1: 2014* | *Design of steel structures. General rules and rules for buildings* |
| ~~*BS EN 1993-1-2: 2005*~~ | ~~*Design of steel structures. General rules – Structural Fire Design*~~ |
| ~~*BS EN 1993-1-3:2006*~~ | ~~*Design of steel structures. General rules – Supplementary rules for cold-formed members and sheeting*~~ |
| ~~*BS EN 1993-1-4-2006 + A1: 2015*~~ | ~~*Design of steel structures. General rules. Supplementary rules for stainless steels*~~ |
| ~~*BS EN 1993-1-5-2006 -A1 2017*~~ | ~~*Design of steel structures. Plated structural elements*~~ |
| ~~*BS EN 1993-1-6-2007 - A1 2017*~~ | ~~*Design of steel structures. Strength and Stability of Shell Structures*~~ |
| ~~*BS EN 1993-1-7-2007*~~ | ~~*Design of steel structures. Plated structures subjected to out of plane loading*~~ |
| ~~*BS EN 1993-1-8:2005*~~ | ~~*Design of steel structures. Design of joints.*~~ |
| ~~*BS EN 1993-1-9: 2005*~~ | ~~*Design of steel structures. Fatigue.*~~ |
| ~~*BS EN 1993-1-10: 2005*~~ | ~~*Design of steel structures. Material toughness and through thickness properties.*~~ |
| ~~*BS EN 1993-1-11-2006*~~ | ~~*Design of steel structures. Design of structures with tension components*~~ |
| ~~*BS EN 1993-1-12-*~~ | ~~*Design of steel structures. Additional rules for the extension of EN 1993 up to*~~ |

| *Reference* | *Title* |
|---|---|
| ~~*2007*~~ | ~~*steel grades S 700*~~ |
| ~~*BS EN 1993-2-2006*~~ | ~~*Design of steel structures. Steel Bridges*~~ |
| ~~*BS EN 1993-3-1-2006*~~ | ~~*Design of steel structures. Towers, masts and chimneys - Towers and masts*~~ |
| ~~*BS EN 1993-3-2-2006*~~ | ~~*Design of steel structures. Towers, masts and chimneys - Chimneys*~~ |
| ~~*BS EN 1993-4-1 2007 + A1 2017*~~ | ~~*Design of steel structures. Silos, tanks and pipelines- Silos*~~ |
| ~~*BS EN 1993-4-2-2007*~~ | ~~*Design of steel structures. Silos, tanks and pipelines- Tanks*~~ |
| ~~*BS EN 1993-4-3 2007*~~ | ~~*Design of steel structures. Silos, tanks and pipelines. Pipelines*~~ |
| *BS EN 1993-5 2007* | *Design of steel structures. Piling* |
| ~~*BS EN 1993-6 2007*~~ | ~~*Design of steel structure. Crane supporting structures*~~ |
| ~~*BS EN 1994-1-1 - 2004*~~ | ~~*Design of composite steel and concrete structures. General rules and rules for buildings*~~ |
| ~~*BS EN 1994-1-2 – 2005+A1: 2014*~~ | ~~*Design of composite steel and concrete structures. General rules - Structural fire design*~~ |
| ~~*BS EN 1994-2 - 2005*~~ | ~~*Design of composite steel and concrete structures. General rules and rules for bridges*~~ |
| ~~*BS EN 1995-1-1:2004+A2:2014*~~ | ~~*Design of timber structures. General. Common rules and rules for buildings*~~ |
| ~~*BS EN 1995-1-2:2004*~~ | ~~*Design of timber structures. General. Structural fire design.*~~ |
| ~~*BS EN 1995-2:2004*~~ | ~~*Design of timber structures. Bridges*~~ |
| ~~*BS EN 1996-1-1: 2005 +A1:2012*~~ | ~~*Design of masonry structures. General rules for reinforced and unreinforced masonry structures.*~~ |
| ~~*BS EN 1996-1-2: 2005*~~ | ~~*Design of masonry structures. General rules – Structural fire design.*~~ |
| ~~*BS EN 1996-2: 2006*~~ | ~~*Design of masonry structures. Design considerations, selection of materials and execution of masonry.*~~ |
| ~~*BS EN 1996-3: 2006*~~ | ~~*Design of masonry structures. Simplified calculations for unreinforced masonry structures.*~~ |
| *BS EN 1997-1: 2004 +A1:2013* | *Geotechnical design. General rules.* |
| *BS EN 1997-2: 2007* | *Geotechnical design. Ground investigation and testing.* |

## Eurocodes – Supplementary documents

| *Reference* | *Title* |
|---|---|
| ~~*PD 6687-1: 2010*~~ | ~~*Background paper to the UK National Annex BS EN 1992-1 and BS EN 1992-3*~~ |
| ~~*PD 6687-2: 2008*~~ | ~~*Recommendations for the design of structures to BS EN 1992-2-2005*~~ |
| ~~*PD 6688-:2011*~~ | ~~*Background paper to the UK National Annex to BS EN 1991-2 Traffic loads on bridges*~~ |

| *Reference* | *Title* |
|---|---|
| ~~*PD 6693-1: 2012*~~ | ~~*Recommendations for the design of timber structures to Eurocode 5*~~ |
| ~~*PD 6694-1:2011*~~ | ~~*Recommendations for the design of structures subject to traffic loading to BE EN 1997-1:2004*~~ |
| ~~*PD 6695-1-9 2008*~~ | ~~*Recommendations for the design of structures to BS EN 1993-1-9*~~ |
| ~~*PD 6695-1-10:2009*~~ | ~~*Recommendations for design of structures to BS EN 1993-1-10*~~ |
| ~~*PD 6695-2-2008 +A1:2012*~~ | ~~*Recommendations for the design of bridges to BS EN 1993*~~ |
| ~~*PD 6696-2 -2007 + A1:2012*~~ | ~~*Background paper to BS EN 1994-2 and the UK NA to BS EN 1994-2*~~ |
| ~~*PD 6697:2010*~~ | ~~*Recommendations for design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2*~~ |
| *BS EN 206: 2013 + A1: 2016* | *Concrete. Specification, performance, production and conformity* |
| ~~*BS EN 338:2016*~~ | ~~*Structural timber – Strength Classes*~~ |
| ~~*BS EN 752: 2017*~~ | ~~*Drain and sewer systems outside buildings. Sewer system management*~~ |
| ~~*BS EN 772-1:2011 +A1:2015*~~ | ~~*Methods of test for masonry units. Determination of compressive strength*~~ |
| ~~*BS EN 1317-5 : 2007 + A2 : 2012*~~ | ~~*Road Restraint systems. Product requirements and evaluation of conformity for vehicle restraint systems*~~ |
| ~~*BS EN 10025-2: 2004*~~ | ~~*Hot Rolled Products of Structural Steels. Technical Delivery Conditions for Non-Alloy Structural Steels*~~ |
| ~~*BS EN 10088-3 2014*~~ | ~~*Stainless Steels – Technical delivery conditions for semi-finished products, bars, roads, wire, sections and bright products of corrosion resisting steels for general purposes.*~~ |
| ~~*BS EN 10210-1: 2006*~~ | ~~*Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Steels.*~~ |
| ~~*BS EN 12812: 2008*~~ | ~~*Falsework – Performance requirements and general design*~~ |
| ~~*BS EN ISO 1461: 2009*~~ | ~~*Hot Dip Galvanised Coatings on Fabricated Iron and Steel Articles – Specifications and Test Methods*~~ |

## Supplementary Info - British Standards

| *Reference* | *Title* |
|---|---|
| *BS 8002:2015* | *Code of practice for earth retaining structures* |
| ~~*BS 476-7: 1997*~~ | ~~*Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products.*~~ |
| ~~*BS 4190: 2014*~~ | ~~*ISO Metric Black Hexagon Bolts, Screws and Nuts – Specification*~~ |
| ~~*BS 4449: 2005+A3:2016*~~ | ~~*Steel for the reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product – Specification*~~ |
| ~~*BS 5975: 2008*~~ | ~~*Code of Practice for Temporary Works Procedures and the Permissible Stress Design of Falsework*~~ |

| *Reference* | *Title* |
|---|---|
| ~~*BS 5977-1: 1981*~~ | ~~*Lintels. Method of Assessment of Load.*~~ |
| ~~*BS 6180:2011*~~ | ~~*Barriers in and about buildings. Code of practice (AMD 13292)*~~ |
| ~~*BS 6187: 2011*~~ | ~~*Code of Practice for Full and Partial Demolition.*~~ |
| ~~*BS 7371-6: 1998 +A1:2011*~~ | ~~*Coatings on Metal Fasteners – Specification for Hot Dip Galvanised Coatings*~~ |
| ~~*BS 8300: 2009 +A1 2010*~~ | ~~*Design of buildings and their approaches to meet the needs of disabled people – Code of practice*~~ |
| *BS 8500-1:2015+A2:2019* | *Concrete – Complementary British Standard to BS EN 206. Part 1: Method of specifying and guidance for the specifier.* |
| ~~*BS 8666: 2005*~~ | ~~*Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete – Specification.*~~ |
| ~~*BS 9999:2008*~~ | ~~*Code of practice for fire safety in the design, management and use of buildings*~~ |

## Design Manual for Roads and Bridges (DMRB)

| *Reference* | *Title* |
|---|---|
| ~~*CD 353*~~ | ~~*Design criteria for footbridges: March 2020*~~ |
| ~~*CD 366*~~ | ~~*Design criteria for collision protection beams: March 2020*~~ |
| ~~*CD 127*~~ | ~~*Cross section and headrooms, inc. Wales National Annex to CD 127: July 2021*~~ |

## Interim Advice Notes

| *Reference* | *Title* |
|---|---|
| ~~*IAN 90/07. Amnt No. 1*~~ | ~~*Guidance for the use of emergency patching materials*~~ |
| ~~*IAN 97/07*~~ | ~~*Assessment and Upgrading of Existing Vehicle Parapets*~~ |
| ~~*IAN 104/15*~~ | ~~*The anchorage of reinforcement & fixings in hardened concrete.*~~ |
| ~~*IAN 124/11*~~ | ~~*Use of Euro codes for the design of highway structures*~~ |
| ~~*IAN 128/15/C*~~ | ~~*Highways Agency Supply Chain Health and Safety Incident Reporting*~~ |

## Other Relevant Documents:

| *Reference* | *Title* |
|---|---|
| ~~*TG 20:13*~~ | ~~*Technical Guidance on the use of BS EN 12811-1*~~ |
| ~~*TG4:17*~~ | ~~*Anchorage Systems for Scaffolding*~~ |
| ~~*TG5:18*~~ | ~~*Technical Guidance. Timber scaffold boards – BS 2482:2009*~~ |
| ~~*SG4:10*~~ | ~~*Preventing Falls in Scaffolding*~~ |
| ~~*SG4:05 Appendix A*~~ | ~~*Interim Guidance on Collective Fall Preventing Systems in Scaffolding*~~ |

## Current Versions of Building Regulations:

| *Approved Document* | *Subject* | *Comments* |
|---|---|---|
| ~~*A - 2010*~~ | ~~*Structure*~~ | |
| ~~*B -2010*~~ | ~~*Fire Safety – Dwelling Houses*~~ | ~~*Also BS9999 applies*~~ |
| ~~*C-2010*~~ | ~~*Site Prep and contaminants and moisture*~~ | |
| ~~*D-2010*~~ | ~~*Toxic substances*~~ | |
| ~~*E-2010*~~ | ~~*Sound*~~ | |
| ~~*F-2010*~~ | ~~*Ventilation*~~ | |
| ~~*G-2010*~~ | ~~*Sanitation*~~ | |
| ~~*H -2010*~~ | ~~*Drainage*~~ | |
| ~~*J- 2010*~~ | ~~*Combustion appliance and fuel storage*~~ | |
| ~~*L1B-2010*~~ | ~~*Conservation of fuel and power in existing dwellings*~~ | |
| ~~*L2A-2010*~~ | ~~*Conservation of fuel and power*~~ | |
| ~~*M -2010*~~ | ~~*Access to and Use of Buildings*~~ | |
| ~~*N-2010*~~ | ~~*Glazing*~~ | |
| ~~*P-2010*~~ | ~~*Electrical*~~ | |
| ~~*Q -2010*~~ | ~~*Security - Dwellings*~~ | |
| ~~*R – 2010*~~ | ~~*Electronic communications*~~ | |

## Other Applicable Standards and Publications:

| *Publisher* | *Title or Criteria* |
|---|---|
| ~~*Department for Transport*~~ | ~~*Accessible Railway Stations: Design Standards – March 2015*~~ |
| *Health and Safety Executive* | *HSG 153/2 - Railway Safety Principles and Guidance Part 2A – Guidance on the Infrastructure* |
| *Health and Safety Executive* | *HSG 153/3 - Railway Safety Principles and Guidance Part 2B – Guidance of Stations* |
| *Health and Safety Executive* | *The Work at Height Regulations 2005 (WAHR)* |
| *Health and Safety Executive* | *The Health and Safety at Work Act (1974)* |
| *Health and Safety Executive* | *The Construction (Design and Management) Regulations (2015)* |
| ~~*Office of Rail Regulation*~~ | ~~*Guidance on minor railways*~~ |
| ~~*Rail Safety and Standards Board*~~ | ~~*Way Finding at Station: A good practice guide. Railway and Safety Standards Boards.*~~ |
| ~~*Sign Design Society (SDS) and Royal National Institute of Blind People ( RNIB)*~~ | ~~*Sign Design Guide, Inclusive signage.*~~ |
| *British Constructional Steelwork Association Ltd* | *National Structural Steelwork Specification for Building Construction – 6th Edition* |

| *Publisher* | *Title or Criteria* |
|---|---|
| *Network Rail Safe by Design* | *Guidance Note – Early Focus on Constructability and Temporary Works Issue 3, 15 May 2019* |
| *BRE* | *BRE Special digest 1 – Concrete in aggressive ground* |
| ~~*BRE*~~ | ~~*BRE 470 – Working Platforms for tracked plant. Good Practice Guide to the design installation, maintenance and repair of ground-supported working platforms.*~~ |

## Railway Group Standards:

| *Reference* | *Title* |
|---|---|
| ~~*RIS-7700-INS*~~ | ~~*Rail Industry Standard for Station Infrastructure*~~ |
| ~~*GC/RT5112*~~ | ~~*Rail Traffic Requirements for the Design of Railway Structures*~~ |
| ~~*GC/RT5161*~~ | ~~*Station Design and Maintenance Requirements*~~ |
| *GC/RT5212* | *Requirements for Defining and Maintaining Clearances* |
| ~~*GI/RT 7016*~~ | ~~*Interface between Station Platforms, Tracks and Trains*~~ |
| ~~*GE/RT 8073*~~ | ~~*Requirements for Applications of Standard Vehicle Gauges*~~ |
| ~~*GE/GN 8573*~~ | ~~*Guidance on Gauging and Platform Distances*~~ |

## Network Rail Standards:

| *Reference* | *Title* |
|---|---|
| ~~*GI/GN 7616 Issue 2*~~ | ~~*Guidance on Interface between Station Platform, Track and Trains.*~~ |
| *NR/CAT/STP/001 Issue 111* | *Catalogue of Network Rail Standards* |
| ~~*NR/CIV/TUM/400 Issue G*~~ | ~~*Eurocode Design Technical User Manual for non-Station Footbridges and Non-Canopy Station Footbridges*~~ |
| ~~*NR/CIV/SD/TUM/600 Issue B*~~ | ~~*Technical User Manual for standard collision protection beams*~~ |
| *NR/CS/CIV/044 Issue 1* | *Managing Structures Work* |
| ~~*NR/GN/ENV/004 Issue 1*~~ | ~~*Waste Management Manual*~~ |
| *NR/L1/CIV/032* | *The Management of Structures* |
| ~~*NR/L1/FIR/100 Issue 6*~~ | ~~*Fire Safety Policy*~~ |
| *NR/L2/AMG/1030 Issue 1* | *Working Safely in the Vicinity of Buried Services* |
| *NR/L2/AMG/1040 Issue 1* | *Buried Services Data Feedback* |
| *NR/L2/CIV/003 Issue 7* | *Engineering and Architectural Assurance of Building and Civil Engineering Works* |
| *NR/L2/CIV/003/F1990 Issue 3* | *Technical Design Requirements for BS EN 1990: Eurocode Basis of Structural Design* |
| ~~*NR/L2/CIV/003/F1991 Issue 3*~~ | ~~*Technical Design Requirements for BS EN 1991: Eurocode 1 Actions on Structures*~~ |

| *Reference* | *Title* |
|---|---|
| ~~*NR/L2/CIV/003/F1992 Issue 3*~~ | ~~*Technical Design Requirements for BS EN 1992: Eurocode 2 Design of Concrete Structures*~~ |
| ~~*NR/L2/CIV/003/F1993 Issue 3*~~ | ~~*Technical Design Requirements for BS EN 1993: Eurocode 3 - Design of Steel Structures*~~ |
| *NR/L2/CIV/003/F1997 Issue 3* | *Technical Design Requirements for BS EN 1997: Eurocode 7 – Geotechnical Design* |
| ~~*NR/L2/CIV/177 Issue 1*~~ | ~~*Monitoring track over or adjacent to building and civil engineering works*~~ |
| *NR/L2/ENV/015 Issue 8* | *Environment and Social Minimum Requirements for Projects – Design and Construction* |
| *NR/L2/INI/02009 Issue 6* | *Engineering Management of Projects- Module 01 - Roles, Responsibilities and Accountabilities* |
| *NR/L2/OHS/0047 Issue 6* | *Application of the Construction, Design & Management Regulations* |
| *NR/L2/OHS/019 /01 Issue 1* | *Safety of People at work on or near the line – Module 01 Planning and working during incident response* |
| *NR/L2/OHS/019 /02 Issue 1* | *Safety of People at work on or near the line – Module 02 Planning and working in a possession* |
| *NR/L2/OHS/019 /03 Issue 1* | *Safety of People at work on or near the line – Module 03 Planning and working using protection arrangements* |
| *NR/L2/OHS/019 /04 Issue 1* | *Safety of People at work on or near the line – Module 04 Planning and working using warning arrangements* |
| ~~*NR/L3/CIV/020 Issue 1*~~ | ~~*Design of Bridges*~~ |
| ~~*NR/L3/CIV/040 Issue 2*~~ | ~~*Specification for the Use of Protective Coatings and Systems*~~ |
| ~~*NR/L3/CIV/065 Issue 6*~~ | ~~*Examination of Earthworks*~~ |
| *NR/L3/CIV/071 Issue 4* | *Geotechnical Design* |
| *NR/L3/CIV//140/73C Issue 2* | *Steel Piles* |
| *NR/L3/CIV/151 Issue 7* | *Engineering and Architectural Assurance of Building and Civil Engineering Works* |
| ~~*NR/L3/CIV/162 Issue 2*~~ | ~~*Platform Extensions*~~ |
| *NR/L3/INI/CP0044 Issue 5* | *Planning and managing construction work,* |
| *NR/L3/INI/CP0063 Issue 1* | *Piling Adjacent to the Running Line* |
| ~~*NR/SP/TRK/036 Issue 2*~~ | ~~*Gauge capability certification*~~ |
| ~~*RT/ENGP/06 Issue 2*~~ | ~~*Buildings, Stations and Depots Engineering Policy*~~ |

## Network Rail Model Clauses

| *NR/L3/CIV/140/....* | *Title* | *Applies* |
|---|---|---|
| *10* | *General* | *√* |
| *21* | *Aerial Survey* | |

| *NR/L3/CIV/140/....* | *Title* | *Applies* |
|---|---|---|
| *22* | *Land and Trackwork Surveys* | |
| *23* | *Structural Repair Survey* | |
| *25* | *Presentation of Survey Data and Information* | *√* |
| *30 - 35* | *General Requirements for Ground Investigation* | *√* |
| *40* | *Demolition and Site Clearance* | *√* |
| *50* | *General Requirements for Earthworks and Excavations* | |
| *51* | *Excavations* | |
| *52* | *Earthworks* | |
| *53* | *Grouting and Lime Stabilisation of Embankments* | |
| *70* | *General Requirements for Piling* | *√* |
| *71* | *Precast Concrete Piles* | |
| *72* | *Cast In Place Piles* | |
| *73* | *Steel Piles* | *√* |
| *74* | *Timber Piles* | |
| *75* | *Testing Piles* | |
| *76* | *General Requirements for Embedded Retaining Walls* | *√* |
| *77* | *Diaphragm Walls* | |
| *78* | *Embedded Retaining Walls Constructed Using Bored Concrete Piles* | |
| *79* | *Sheet Pile Walls* | *√* |
| *80* | *Structural Concrete* | |
| *83* | *Structural Concrete Repairs* | |
| *85* | *Concrete for Ancillary Purposes* | |
| *93* | *Structural Steelwork Repairs* | |
| *100* | *Bearings* | |
| *110* | *General Requirements for Waterproofing Underline Bridges* | |
| *111* | *Tightly Bonded Systems for Underline Bridges* | |
| *112* | *Loose-Laid Systems for Underline Bridges* | |
| *113* | *Waterproofing for Road Carrying Bridges* | |
| *114* | *Tanking* | |
| *120* | *General Requirements for Bridge Installation Methods and Temporary Works* | |
| *121* | *Bridge Installation by Sliding or Rolling* | |
| *122* | *Bridge Installation by Large Capacity Crane* | |
| *123* | *Bridge Installation Using Self Propelled Lifting Vehicles* | |
| *124* | *Temporary Works – Tunnel Constructed Using Shield* | |
| *125* | *Bridge Installation by Thrust Boring* | |

| *NR/L3/CIV/140/....* | *Title* | *Applies* |
|---|---|---|
| *126* | *Temporary Bridges* | |
| *130* | *General Requirement for Inspection of New Steelwork, Precast Concrete, Protective Treatment and Waterproofing* | |
| *150* | *Brickwork, Blockwork and Masony* | |
| *153* | *Brickwork and Masonry Repairs* | |
| *160* | *General Requirements for Structural Timber* | |
| *160GN* | *Guidance Note for Structural Timber* | |
| *161* | *Design Requirements for Structure Timber* | |
| *162* | *Workmanship for Structural Timber* | |
| *163* | *Maintenance and Repair* | |
| *164* | *Timber Preservation and Fire Protection* | |
| *170* | *General Requirements for Protective Treatment* | |
| *171* | *Maintenance Coating Works* | |
| *172* | *Protective Coating of New Structural Steelwork* | |
| *173* | *Protective Coating of Existing Structural Steelwork and Ironwork* | |
| *174* | *Protective Coating of Timber Surfaces* | |
| *175* | *Protective Coating of Concrete and Masonry Surfaces* | |
| *176* | *Protective Coating Systems* | |
| *180* | *General Requirements for Building and Structure Drainage* | |
| *185* | *Track Drainage* | |
| *190* | *External Service Ducts and Cable Troughing* | |
| *200* | *General Requirements for Roads and Pavings* | |
| *201C* | *Subgrade and Formation Works* | |
| *202* | *Road Pavements* | |
| *203* | *Kerbs, Footways and Paved Areas* | |
| *204* | *Traffic Signs and Road Markings* | |
| *230* | *General Requirements for Level Crossings* | |
| *231* | *Public Vehicular Level Crossings* | |
| *232* | *Occupation and Accommodation Level Crossings* | |
| *233* | *Footpath, Bridleway and Other Types of Level Crossings* | |
| *240* | *Fencing and Gates* | |
| *250 - 253* | *Landscaping - Preparation of Topsoil* | |
| *255* | *General Requirements for the Management of Lineside Vegetation* | |

## 1.4 Variations to standards (with justification)

None.

## 1.5 Other relevant information

### Drainage

Back of wall drainage and weep holes are not required because the joints between the piles will be free draining. The structure will have a negligible effect on the ground water regime.

### Void grouting

Voids observed during the demolition of the existing concrete should be demarcated. Grout injection into known voids should be undertaken following the construction of the sheet pile wall. Designer to be present during construction to aid with demarcation injection grid.

Cement grout injection to be used, with a minimum compressive strength of 20 N/mm$^2$. Grout cube testing to be undertaken to confirm grout conforms to the specification.

### Concrete backfill

Concrete exposure class XAS (unreinforced concrete exposed to sea water). Limiting values for concrete composition as per Table A.13 of BS 8500-1:2015+A2:2019, minimum indicative compressive strength class C20/C25.

### Rock armour

3-6t rock armour shall be placed in front of the retaining wall up to the crest along the entire extent, reducing in height at a gradient of 1V:2.75H (20 °).

### Construction sequence

Envisaged sequence of works is as follows:

1. Removal of existing sheet piles and demolition of concrete overhang.
2. Demarcation of voids beneath existing footpath.
3. Installation of new sheet piles.
4. Concrete backfill in 0.5 m thick layers, waiting for curing between layers.
5. Grout injection into known voids through existing footpath.
6. Placement of rock armour scour protection.

### Buried services

Buried service information has not been provided at this stage and should be sought before works are to commence on site.

### Designers risk assessment

A design risk assessment has been produced (Document Ref. 23162B-DRA-001).

## 1.6 Requirements for operation, inspection, maintenance, repair, renewal or removal including special access arrangements

Routine inspections required as per Network Rail procedures for coastal structures.

## 1.7 Temporary Works

A temporary piling platform and access ramp are likely to be required. Temporary works design is outside the scope of this document and the design remit at this stage.

## 1.8 Detailed Design Drawings and Models

Design drawings are included in Appendix B.

| Document Number | Title | Revision |
|---|---|---|
| 23162B-001 | GA on proposed sheet pile wall and rock armour | B02 |
| 23162B-002 | Proposed sections | B02 |

## 1.9 Accompanying drawings and other documents

| Document type | Document number | Appendix |
|---|---|---|
| Designer's Risk Assessment | 23162B-DRA-001 | Appendix A |
| Drawing – GA | 23162B-001 | Appendix B |
| Drawing - Sections | 23162B-002 | |

## 1.10 Matters that have been considered in the Design

*The matters that do not apply to the Works to meet the particular CR-T and Requirements documents are to be struck out by the approved CRE appointed for the Design phase*

1. So far as is reasonably practicable, the Asset affected will be safe in use when used in accordance with its intended purpose.
2. Hazards are managed in accordance with requirements of the CDM Regulations and CSM regulations. Residual risks are documented in a Risk Register. Risks to both (a) health and safety during construction, maintenance, use, railway operations and (b) occupational health and safety, are as low as reasonably practicable or better.
3. The provisions for examination, maintenance and eventual renewal/removal are satisfactory.
4. The overall Design concept and the appearance of the infrastructure are appropriate for their purpose, location and site conditions.
5. Where the proposal includes the strengthening, partial renewal or removal of structures, the stability of the whole structure and all its parts/elements at all stages of the Works are addressed, including the long-term adequacy of the remaining parts/elements of the structure and supporting soil.

6. The effects of the proposals on existing infrastructure are adequately considered.
7. Arrangements for liaison and consultation with external bodies (such as Local Authorities, statutory undertakers, the British Transport Police, the Environmental Regulators and landowners) are satisfactory and the likely effects of the proposals on external organisations are addressed. Required Permissions/Approvals have been obtained to support the proposals.
8. The impact of the proposals on services and service routes is adequately investigated and appropriate mitigation measures have been agreed with the appropriate Authority and incorporated into the Design.
9. The effects on other rail engineering disciplines including track, gauging, signalling (including signal sighting), telecommunications, electrification, lighting, and other operational electrical and mechanical equipment have been satisfactorily considered and no interfaces have been identified which would negate the use of this FormG to NR/L2/CIV/003 clause 12.2.
10. Mining related risks have been assessed in the development of the proposed design and are considered to be acceptable, in accordance with **NR/L2/CIV/191/MOD05.**
11. The requirements/recommendations of Railway Group Standards and RIS, Network Rail standards and Department for Transport Design Standards for Accessible Railway Stations have been addressed and proposed variations from these standards are identified and justified.
12. ~~The requirements of the Building Regulations are met and any planning conditions are met.~~
13. The proposed Design loadings are appropriate, and any non-standard accidental loadings are correctly identified.
14. The requirements of **NR/L2/CIV/003/F1990** to **NR/L2/CIV/003/F1994** and **NR/L2/CIV/003/F1997** have been considered and the selected options/choice recorded in this design.
15. The proposed Design standards and methods of Design are suitable.
16. The GIR/GDR information presented in or referred to in this combined design submission FormG is appropriate for the detailed design and assumptions have been verified or measures for verification of assumptions have been incorporated in the detailed design.
17. A Geotechnical Design Report, which meets the requirements of BS EN 1997 and NR/L3/CIV/071 is available. This Report justifies the selection of the Geotechnical Design parameters and outlines any further work required for implementation.
18. A plan of geotechnical related construction supervision and monitoring (including details of items to be checked during construction or requiring maintenance or monitoring) have been incorporated in the detailed design and meet the requirements of BS EN 1997.

~~19. The Design complies with structure clearance and platform stepping distance requirements.~~

~~20. Important Design matters not covered by standards are identified.~~

21. The proposals are economical.
22. The proposed works will not compromise the structural robustness of any existing structures.
23. The proposals have considered requirements for environmental and sustainable development. The design has adequately considered the results and actions required from the Environmental and Social Appraisal and the Environmental and Social Management Plan, where required by NR/L2/ENV/015.

~~24. The selection of post-installed anchors in concrete and masonry meet the requirements of BS 8539.~~

25. All materials specified in the design of structures are compatible with the intended application and environment. This includes, but is not limited to:
    - fixing metallic structures to masonry with studs bonded with resin, grout or other chemical bonding products
    - fixing design is to current standards and guidance
    - design and installation comply with manufacturer's requirements, are compatible with substrate and includes appropriate verification testing
    - building fabric design and associated fixings are appropriate for the security risk and associated requirements
    - suitable and sufficient investigation, as far as reasonably practical, has been carried out to determine that materials to be used will be compatible.
    - Design calculations have been completed where applicable and checked in accordance with the Design Check Category.
26. The provision of this design on this FormG meets with the requirements of NR/L2/CIV/003 clause 12.2.
27. A completed IDC certificate has been provided with this design to comply with NR/L2/RSE/02009 clause 15.3
28. A Designers Risk Assessment has been provided with this design.
29. The Permanent Works designer has outlined their proposed construction methodology and envisaged temporary works requirements in order to facilitate construction of the Permanent Works.
30. The Permanent Works designer has outlined their proposed construction methodology and envisaged temporary works requirements to comply with the Diversity Impact Assessment (DIA), e.g., provision of temporary structures such as accessible temporary footbridges

31. The provision of new assets has taken account of the effects on existing assets, such as effects on cuttings, embankments, other structures or GSM-R.
32. ~~The design has adequately considered pedestrian flow, fire risk, means of escape and security requirements.~~
33. A specification of workmanship and materials has been provided with the detailed design submission.

## PART 2: DESIGNER'S SUBMISSION

I confirm:

1. that the criteria specified in NR/L2/CIV/003 have been considered and:

   (a) this combined design submission FormG, incorporating Approval in Principle Design, Statement of Design Intent and Design and Check certificate, is submitted on behalf of *Crouch Waterfall, 15 Apex Court, Woodlands, Bristol, BS32 4JT*

2. that reasonable professional skill and care have been used with the objective of checking that the Design:

   (a) unless identified in 1.4, (i) the Design will comply with all relevant standards and will be delivered in accordance with the CR-T/Requirements documents and (ii) the deliverables identified within the CR-T/Requirements documents have been completed and submitted in support of this submission.

   (b) complies with the design standards, codes and methods stated in **PART 1**.

   (c) is accurately described by the drawings, models, schedules, performance, materials and workmanship specifications, list of matters that have been considered in the design and other documents in **PART 1,** that have been prepared for issue as Approved for Construction (AFC) pending the completion of **PART 5, PART 5A** and **PART 6** of this form

   (d) incorporates any feedback from Network Rail on any pre-submission design development work

| Signed | Digitally signed by Vera Faustino<br>Date: 2023-07-03 10:52+01:00 | Title **Principal Geotechnical Engineer** |
|---|---|---|
| Name (print) **Vera Faustino** | | Date **03.07.2023** |
| To be signed by the Contractor's Responsible Engineer. | | |

## PART 3: CHECK

I certify that reasonable professional skill and care have been used in checking the Design identified in **PART 1** of this submission, with the objective of checking that the Design

(a) complies with the Design standards, codes and methods and other requirements stated in **PART 1** of this submission.

(c) was checked as stated in **PART 1** and has been carried out with the level of independence specified in **NR/L2/CIV/003**

| Signed | Title **Associate** |
|---|---|
| Name (print) **Dave Brock** | Date **03.07.2023** |
| To be signed by the Checker | |

## PART 4: CONSTRUCTION ORGANISATION'S ACKNOWLEDGEMENT OF COMBINED SUBMISSION BY A SUB-CONTRACT DESIGNER

The organisation named in **PART 2** is engaged as a sub-contractor to the organisation stated below. I acknowledge this combined submission to Network Rail in support of our contract obligation for the provision of this design on behalf of

MPH Construction Ltd
Bromfield House
Bromfield Industrial Estate
Queens Lane, Mold
Flintshire
CH7 1XB

I confirm that, unless stated in **PART 2**, the submission complies with the CR-T.

| Signed | Title |
|---|---|
| Name (print) | Date |
| To be signed by the Contractor's Responsible Engineer appointed for the Construction phase | |

## PART 5: PROJECT ENGINEER'S COMMENTS AND ACCEPTANCE ON BEHALF OF NETWORK RAIL

I have considered the combined design submission and confirm that the information specified in **NR/L2/CIV/003** and the CR-T/Requirements document is included in this submission. My comments on the submission are in the associated closed out DRN.

I have reviewed the combined submission and confirm that, unless stated in **PART 1**, it complies with the Asset Manager's requirements for this project as set out in the Requirements documents and CR-T.

I accept that, so far as can reasonably be ascertained from the information submitted, the relevant procedures for the Design and Design Check as specified in **NR/L2/CIV/003** have been followed properly.

I have considered the Design Check statement provided in accordance with 12.2 of **NR/L2/CIV/003** and confirm that the stated method of checking was suitable and that all criteria for the use of this FormG have been satisfied.

I confirm that the Design has been checked in accordance with **NR/L2/CIV/003** with the design check categories agreed with the DPE as listed in Part 1;

| Signed | Title |
|---|---|
| Name (print) | Date |
| To be signed by the Project Engineer (Building and Civil Engineering) | |

| Signed | Title |
|---|---|
| Name (print) | Date |
| To be signed by other responsible person *(if applicable)*<br>(Project Engineer (Building Services) for example) | |

## PART 5A: SUPPLEMENTARY NETWORK RAIL REVIEWER ENDORSEMENT

### Security, Emergency and Contingency Review

My comments on the submission are given below. Provided that these comments are addressed, I hereby endorse this combined design submission FormG submission of the above proposals regarding the security arrangements of railway infrastructure.

| Signed | Title |
|---|---|
| Name (print) | Date |
| To be signed by the competent security role holder assigned to the project | |

### Station Pedestrian Capacity and Evacuation Review

My comments on the combined submission are given below. Provided that these comments are addressed, I hereby endorse this combined design submission FormG of the above proposals regarding Station capacity and evacuation.

| Signed | Title |
|---|---|
| Name (print) | Date |
| To be signed by the Network Rail Capacity Engineer | |

### Fire Safety Review

My comments on the combined submission are given below. Provided that these comments are addressed, I hereby endorse this combined design submission FormG of the above proposals regarding Fire Safety.

| Signed | Title |
|---|---|
| Name (print) | Date |
| To be signed by the Network Rail Fire Engineer | |

## PART 6: ASSET MANAGER'S APPROVAL

I have considered the combined submission and confirm that the proposed–deviations to the Requirements documents / CR-T *(delete as appropriate)* are acceptable subject to any comments listed below being addressed prior to proceeding to Approved for Construction (AFC) Design as defined in NR/L2/RSE/02009. (Statement to be struck out where deviation from the Project Requirements is not being sought).

I have considered the combined design submission FormG and confirm that this is approved subject to the comments given below being addressed prior to proceeding to Approved for Construction (AFC) Design as defined in NR/L2/RSE/02009.

| Signed | Title |
|---|---|
| Name (Print) | Date |
| To be signed by the Asset Manager (Structures) | |

| Signed | Title |
|---|---|
| Name (Print) | Date |
| To be signed by the Asset Manager (Geotechnical) | |

| Signed | Title |
|---|---|
| Name (Print) | Date |
| To be signed by the Asset Manager (Drainage) | |

| Signed | Title |
|---|---|
| Name (Print) | Date |
| To be signed by the Asset Manager (Buildings) | |

## Appendix A – Designer's Risk Assessment

# Designer's Risk Assessment

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Title of Scheme | *Afon Wen MPH* | | | Document Ref | 23162B-DRA-001 | Revision | A01 |
| Location | *Afon Wen* | | | Date of Issue | 27/06/2023 | | |
| ELR | DJP | Mileage | *127m 61ch* | O.S Grid Ref | SH 44803 37183 | Structure No | *N/A* |

Normal Hazards:
It is assumed that normal site-based risks will be identified and addressed by the competent contractor with experience of undertaking construction in a Railway environment. These hazards include, but are not restricted to, injury from falling, tripping, lifting materials, contact with substances hazardous to health, etc.

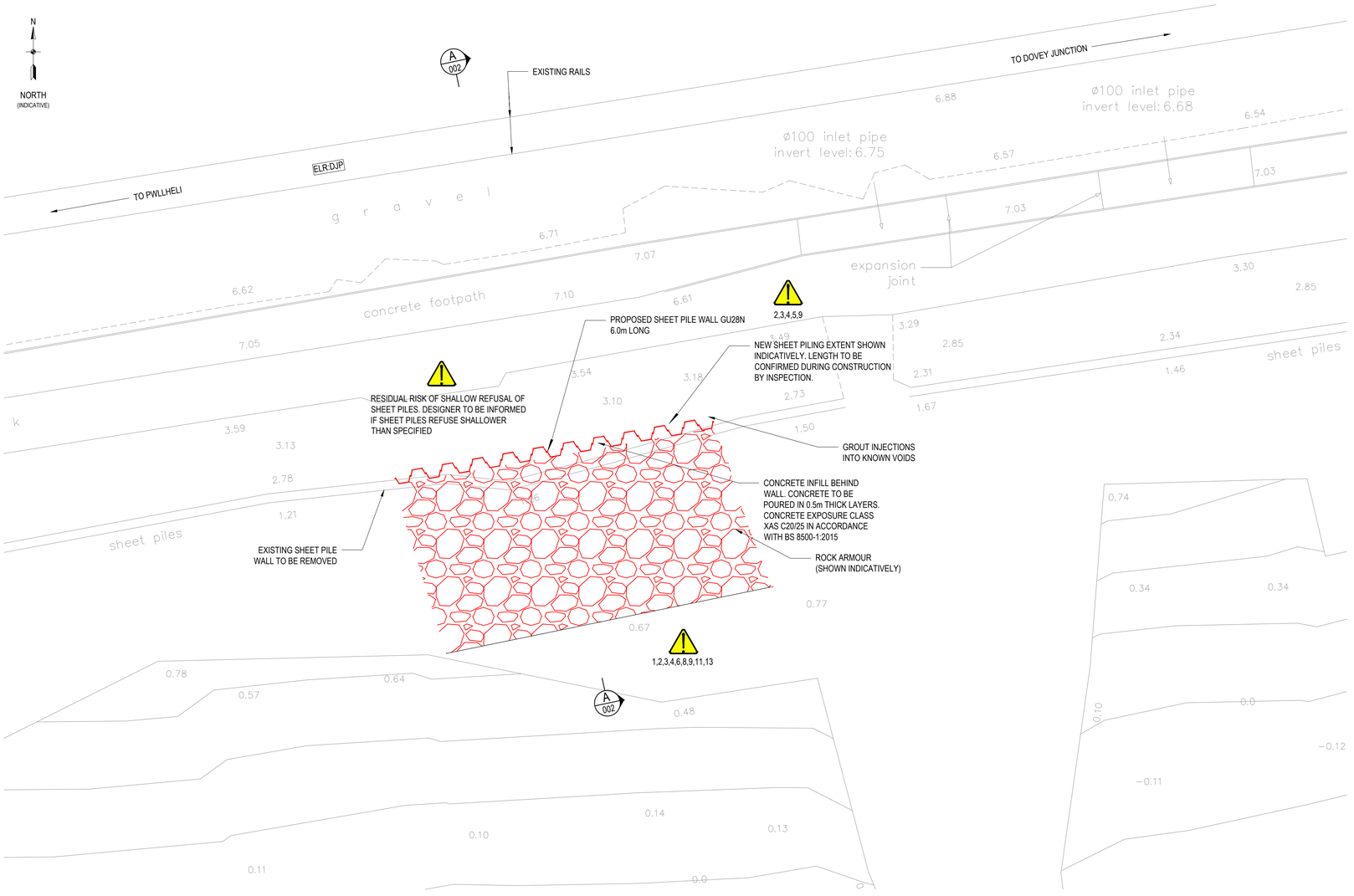
| Ref | Residual risk | Activity / Element | Risk | Action at Design Stage | Risk Mitigation by Contractor | Initial | Date |
|---|---|---|---|---|---|---|---|
| 01 | Working in tidal areas | All works | High | Risk noted. | Works programme to account for high and low tide. Access arrangements to be established prior to the works commencing.<br><br>Contractor to consider the use of life jackets for site staff when working near water. | WE | 27/06/2023 |
| 02 | Fall from height | All works | High | Risk noted | Appropriate safe systems of work to be put in place (e.g., edge protection) | WE | 27/06/2023 |
| 03 | Uneven ground, slips, trips and falls | All works | High | Risk noted. | Site staff to wear appropriate PPE. Contractor should establish safe access route for pedestrian staff. | WE | 27/06/2023 |
| 04 | Inclement weather | All works | High | Risk noted. | Contractor to postpone works in the event of inclement weather such as a storm or high winds if deemed unsafe to carry out construction activities. | WE | 27/06/2023 |
| 05 | Train movements | All works | Medium | Risk noted. | Suitable rail safety precautions to be in place for near the line (e.g., plant toppling risk assessment). | WE | 27/06/2023 |
| 06 | Ecology/environment | All works | Medium | Risk noted. | Contractor to ensure necessary control measures are in place to prevent pollution of coastal waters.<br><br>Contractor to ensure necessary ecological/environmental licenses are in place for the works. | WE | 27/06/2023 |
| 07 | Deterioration of concrete | Structural repairs | High | Concrete exposure class XAS specified. | Contractor to ensure correct concrete is supplied to site. Appropriate testing to be undertaken by the Contractor. | WE | 27/06/2023 |

# Designer's Risk Assessment

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Title of Scheme | *Afon Wen MPH* | | | Document Ref | 23162B-DRA-001 | Revision | A01 |
| Location | *Afon Wen* | | | Date of Issue | 27/06/2023 | | |
| ELR | DJP | Mileage | *127m 61ch* | O.S Grid Ref | SH 44803 37183 | Structure No | *N/A* |

| Ref | Residual risk | Activity / Element | Risk | Action at Design Stage | Risk Mitigation by Contractor | Initial | Date |
|---|---|---|---|---|---|---|---|
| 08 | Noise leading to damaged hearing | Sheet pile installation | High | Risk noted. | Site staff to wear appropriate hearing protection during sheet pile installation. | WE | 27/06/2023 |
| 09 | Working with concrete | Structural repairs | High | Risk noted. | Site staff to wear appropriate PPE when working with concrete. | WE | 27/06/2023 |
| 10 | Scour | Rock armour / sheet piles | High | Replenishment/extension of rock armour where required.<br><br>Replacement of displaced sheet piles and installation of new sheet piles. | None. | WE | 27/06/2023 |
| 11 | Shallow refusal of sheet piles | Sheet pile installation. | Low | Interpretation of ground investigation and potential bedrock level.<br><br>Design embedded length unlikely to be below bedrock therefore risk mitigated. Risk noted on drawings. | Contractor to inform designer immediately if sheet piles do not achieve specified depth. | WE | 27/06/2023 |
| 12 | Corrosion of sheet piles | Sheet piles | Medium | Structural capacity checks undertaken for reduced thickness sheet piles.<br><br>Corrosion assessed in accordance with BS EN 1993-5:2007 for steel in low water and tidal splash zones. | None. | WE | 27/06/2023 |
| 13 | Displacement of sheet piles during concrete backfill | Backfilling sheet pile wall | High | Displacement analysed for construction in SLS. Force applied to simulate pouring of wet concrete. Maximum displacement satisfies BS EN 1997-1.<br><br>Concrete pours in 0.5 m thick layers specified. Previous layer to cure before pouring next layer. | Pour concrete in 0.5m thick layers. Previous layer to cure before pouring next layer. | WE | 27/06/2023 |
| 14 | Groundwater behind sheet pile | Sheet piles | Medium | ULS and SLS analysis to consider groundwater level behind the wall at crest. This is to simulate the scenario where tidal water drains from behind the wall slower than the tide recedes. | None. | WE | 30/06/2023 |

## Appendix B – Design Drawings




GA ON PROPOSED SHEET PILE
WALL AND ROCK ARMOUR
SCALE 1:100

NOTE:

PROPOSED PLAN HAS BEEN BASED ON A TOPOGRAPHICAL SURVEY CERD-AFON WEN; AFON WEN FARM, LL53 6TX- TOPOGRAPHICAL SURVEY- SHEET 1 OF 2 PRODUCED MAY 2023 BY AZIMUTH LAND SURVEYS LIMITED SENT TO CROUCH WATERFALL & PARTNERS

COLOUR LEGEND

- EXISTING OR UNCHANGES
- MODIFIED OR MOVED
- NEW, PROPOSED OR ADDITIONAL
- OS OR SURVEY DATA
- REDUNDANT OR TO BE MOVED
- TEMPORARY WORKS

| | HEALTH AND SAFETY- REFER TO THE DESIGNERS RISK ASSESMENT FOR MORE INFORMATION (23162B-DRA-001) | |
|---|---|---|
| **REF** | **RESIDUAL RISK** | **ACTIVITY/ELEMENT** |
| 1 | WORKING IN TIDAL AREAS | ALL WORKS |
| 2 | FALL FROM HEIGHT | ALL WORKS |
| 3 | UNEVEN GROUND, SLIPS,TRIPS AND FALLS | ALL WORKS |
| 4 | INCLEMENT WEATHER | ALL WORKS |
| 5 | TRAIN MOVEMENT | ALL WORKS |
| 6 | ECOLOGY/ ENVIRONMENT | ALL WORKS |
| 7 | DETERIORATION OF CONCRETE | STRUCTURAL REPAIRS |
| 8 | NOISE LEADING TO DAMAGED HEARING | ALL WORKS |
| 9 | WORKING WITH CONCRETE | ALL WORKS |
| 10 | SCOUR | STRUCTURAL REPAIRS |
| 11 | SHALLOW REFUSAL OF SHEET PILES | SHEET PILE INSTALLATION |
| 12 | CORROSION OF SHEET PILES | SHEET PILE |
| 13 | DISPLACEMENT OF SHEET PILES DURING CONCRETE BACKFIL | BACKFILLING SHEET PILE WALL |
| 14 | GROUNDWATER BEHIND SHEET PILE | SHEET PILE |

20 0 20 40 60 80

100mm ON ORIGINAL DRAWING

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM UNLESS NOTED OTHERWISE
3. ALL DIMENSIONS AND LEVELS ARE TO BE CHECKED ON SITE PRIOR TO ANY WORKS BEING PUT IN HAND.
4. THE CONTRACTOR IS RESPONSIBLE FOR THE STABILITY OF THE EXISTING STRUCTURE AT ALL TIMES DURING THE WORKS.
5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER CONTRACT DRAWINGS AND RELEVANT SPECIFICATIONS.
6. ANY DISCREPENACIE BETWEEN THE INFORMATION GIVEN TO BE BROUGHT TO ATTENTION OF THE ENGINEER AS SOON AS POSSIBLE.
7. ALL MATERIALS USED IN THE WORKS SHALL BE TO BRITISH STANDARDS OR OTHER APPLICABLE SPECIFICATIONS
8. ALL WORKS IS TO BE CARRIED OUT TO B.S CODES OF PRACTICE AND IN ACCORDANCE WITH GOOD WORKMANSHIP PRACTICE.
9. ALL PROPRIETARY MATERIALS USED IN WORKS ARE TO BE USED IN COMPLETE ACCORDANCE WITH MANUFACTURERS RECCOMENDATIONS.

AFON WEN


SITE LOCATION
NTS
OS GRID REFERENCE: SH 44800 37100

FOR APPROVAL

| | | | | | |
|---|---|---|---|---|---|
| B02 | ISSUE FOR COMMENT | MS | WE | VF | 30/06/2023 |
| B01 | ISSUE FOR COMMENT | MS | WE | VF | 23/06/2023 |
| A01 | DRAFT ISSUE FOR INFORMATION | MS | WE | VF | 19/06/2023 |
| REV | AMENDMENT | DRN | CHK | APP | DATE |


Unit 15 Apex Court
Woodlands
Bradley Stoke
Bristol
BS32 4JT

Tel 01454 270 707
office@crouchwaterfall.co.uk


CROUCH WATERFALL

CLIENT

MPH CONSTRUCTION

PROJECT TITLE

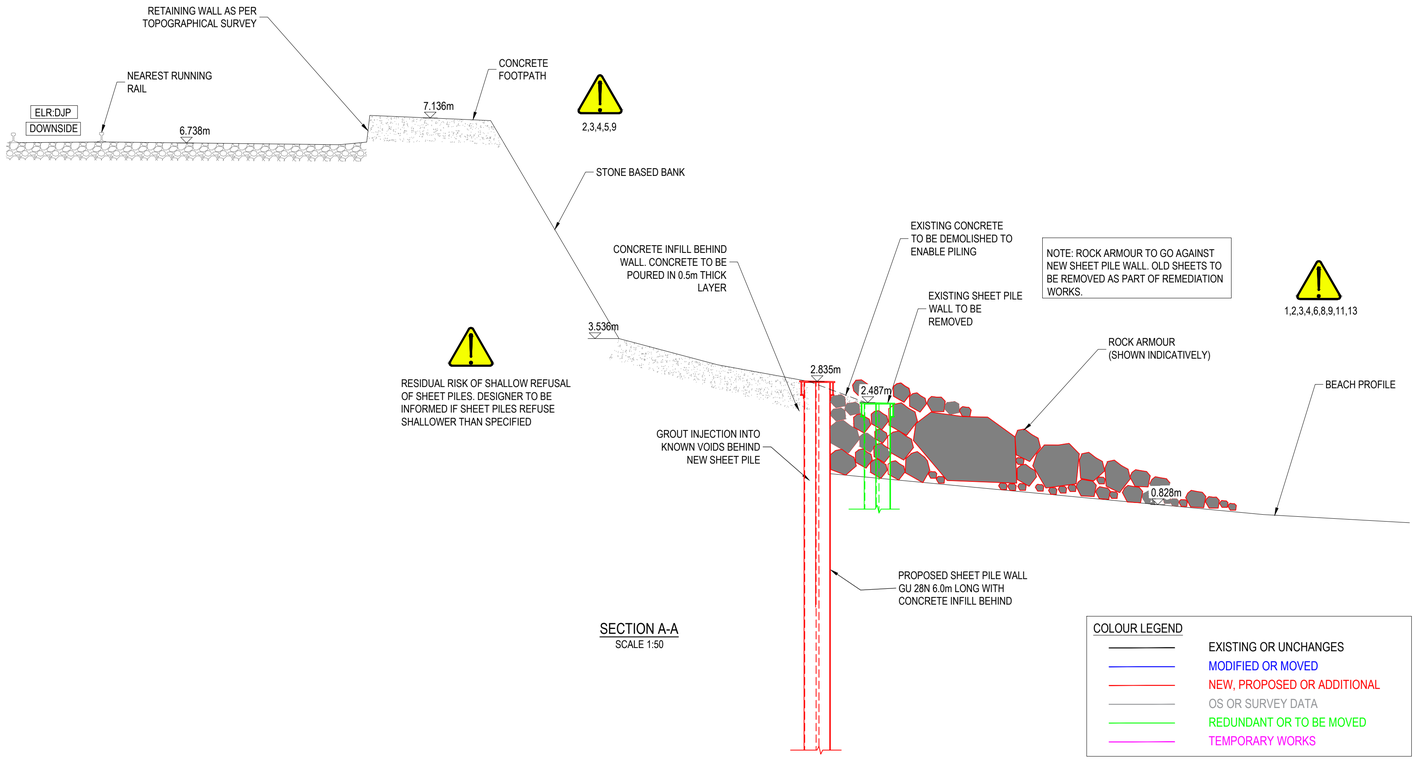
AFON WEN
ELR:DJP
MILEAGE 127m 61ch-128m 11ch

DRAWING TITLE

GA ON PROPOSED SHEET PILE
WALL AND ROCK ARMOUR

| DRAWN | CHK | APP | DATE | SCALE |
|---|---|---|---|---|
| MS | WE | VF | JUN 23 | AS SHOWN AT A1 |

| PROJECT NUMBER | DRAWING NUMBER | REVISION |
|---|---|---|
| 23162B | 001 | B02 |




SECTION A-A
SCALE 1:50

COLOUR LEGEND

- EXISTING OR UNCHANGES
- MODIFIED OR MOVED
- NEW, PROPOSED OR ADDITIONAL
- OS OR SURVEY DATA
- REDUNDANT OR TO BE MOVED
- TEMPORARY WORKS

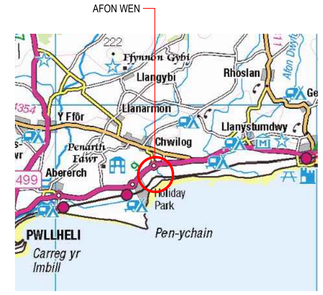
| | HEALTH AND SAFETY-REFER TO THE DESIGNERS RISK ASSESMENT FOR MORE INFORMATION (23162B-DRA-001) | |
|---|---|---|
| **REF** | **RESIDUAL RISK** | **ACTIVITY/ELEMENT** |
| 1 | WORKING IN TIDAL AREAS | ALL WORKS |
| 2 | FALL FROM HEIGHT | ALL WORKS |
| 3 | UNEVEN GROUND, SLIPS,TRIPS AND FALLS | ALL WORKS |
| 4 | INCLEMENT WEATHER | ALL WORKS |
| 5 | TRAIN MOVEMENT | ALL WORKS |
| 6 | ECOLOGY/ ENVIRONMENT | ALL WORKS |
| 7 | DETERIORATION OF CONCRETE | STRUCTURAL REPAIRS |
| 8 | NOISE LEADING TO DAMAGED HEARING | ALL WORKS |
| 9 | WORKING WITH CONCRETE | ALL WORKS |
| 10 | SCOUR | STRUCTURAL REPAIRS |
| 11 | SHALLOW REFUSAL OF SHEET PILES | SHEET PILE INSTALLATION |
| 12 | CORROSION OF SHEET PILES | SHEET PILE |
| 13 | DISPLACEMENT OF SHEET PILES DURING CONCRETE BACKFIL | BACKFILLING SHEET PILE WALL |
| 14 | GROUNDWATER BEHIND SHEET PILE | SHEET PILE |

20 0 20 40 60 80

100mm ON ORIGINAL DRAWING

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM UNLESS NOTED OTHERWISE.
3. ALL DIMENSIONS AND LEVELS ARE TO BE CHECKED ON SITE PRIOR TO ANY WORKS BEING PUT IN HAND.
4. THE CONTRACTOR IS RESPONSIBLE FOR THE STABILITY OF THE EXISTING STRUCTURE AT ALL TIMES DURING THE WORKS.
5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER CONTRACT DRAWINGS AND RELEVANT SPECIFICATIONS.
6. ANY DISCREPENACIE BETWEEN THE INFORMATION GIVEN TO BE BROUGHT TO ATTENTION OF THE ENGINEER AS SOON AS POSSIBLE.
7. ALL MATERIALS USED IN THE WORKS SHALL BE TO BRITISH STANDARDS OR OTHER APPLICABLE SPECIFICATIONS.
8. ALL WORKS IS TO BE CARRIED OUT TO B.S CODES OF PRACTICE AND IN ACCORDANCE WITH GOOD WORKMANSHIP PRACTICE.
9. ALL PROPRIETARY MATERIALS USED IN WORKS ARE TO BE USED IN COMPLETE ACCORDANCE WITH MANUFACTURERS RECCOMENDATIONS.




SITE LOCATION
NTS
OS GRID REFERENCE: SH 44800 37100

FOR APPROVAL

| REV | AMENDMENT | DRN | CHK | APP | DATE |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| B02 | ISSUE FOR COMMENT | MS | WE | VF | 30/06/2023 |
| B01 | ISSUE FOR COMMENT | MS | WE | VF | 23/06/2023 |
| A01 | DRAFT ISSUE FOR INFORMATION | MS | WE | VF | 19/06/2023 |

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CROUCH WATERFALL

CLIENT

MPH CONSTRUCTION

PROJECT TITLE

AFON WEN
ELR:DJP
MILEAGE 127m 61ch-128m 11ch

DRAWING TITLE

PROPOSED SECTIONS

| DRAWN | CHK | APP | DATE | SCALE |
|---|---|---|---|---|
| MS | WE | VF | JUN 23 | AS SHOWN AT A1 |

| PROJECT NUMBER | DRAWING NUMBER | REVISION |
|---|---|---|
| 23162B | 002 | B02 |