DESIGN STATEMENT

EDINBURGH TRAM YORK PLACE TO NEWHAVEN

BALFOUR STREET TRAM STOP

PROJECT				ORIGIN			VOLUME			LEVEL		TYPE		ROLE	NUMBER				REV		
E	T	Y	N	S	E	F	X	X	X	0	2	R	P	A	0	0	0	1	P	0	1

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1 INTRODUCTION

This Design Statement sets out the developed design of Balfour Street tram stop that forms part of the York Place to Newhaven project. This phase of the project takes the tram stops outline design as carried out at ECI stage to the next stage of detail. This chiefly involves preliminary coordination of major elements that converge at tram stops such as OLE poles, TEC cabinets, cabling and ducting trenches and inspection chambers, drainage channels, pipes and inspection chambers.

This Design Statement provides the details of the design for major elements at tram stops such as equipment poles footings, furniture and shelter foundations.

The tram stops design at DD stage has taken into account requirements for tram stop equipment such as field of vision for CCTV cameras, layout and position of platform duct banks and inspection chambers.

Tram stop drainage has also been developed including proposals for tie into the route-wide system.

Other systems present at tram stops such as earthing and bonding and lighting are to be developed separately as part of the route-wide design.

This Design Statement explains the design principles on which the development is based. The design statement illustrates why the selected design solution is the most suitable in the circumstances in terms of the structures and the quality of spaces created.

2 OBJECT AND SCOPE

2.1 Object

The object of this report is to describe the developed design work carried out as part of the Balfour Street tram stop design. The object of the tram stop developed design is to include coordinated and updated proposals for civil, systems and other services design. The level of detail has been assumed to be equivalent to RIBA stage 3 (2013 plan of work). This report, in conjunction with the corresponding drawings, provides details of the proposed tram stop and explains the rationale for the proposed design.

2.2 Scope

The level of detail is limited to the equivalent of RIBA stage 3 (RIBA 2013 plan of work).

Tram stop developed design takes the coordination of the following disciplines with tram stop civil design to the next level:

- Drainage: tram stop drainage has been designed to schematic level. Tie-in with system wide drainage has also been proposed.
- Cabling and ducting: tram stop duct banks and inspection chambers have been proposed in coordination with the current setting out of all tram stop equipment and the TEC at each stop. Tie-in with system wide comms and power infrastructure has been proposed.
- OLE posts: setting out has been coordinated with tram stop platform setting out and tram stop equipment posts, considering requirements such as CCTV fields of vision.
- Track works: detailed analysis of stepping distance.
- Public Realm design: initial tie-in with proposals for public realm.

The application for prior approval for Balfour Street tram stop is one of a series of applications in connection with the extension of the tram from York Place to Newhaven. In total, eight tram stops are proposed including:

- Picardy Place – Island and side platform (replaces York Place temporary stop).
- McDonald Road – Island platform
- Balfour Street – Island platform
- Foot of the Walk – Side platform
- Bernard Street – Island platform
- Port of Leith – Island platform
- Ocean Terminal – Island platform
- Newhaven (terminus) – Side platform

The elements included within this application include:

- Passenger help / passenger emergency call points (PHP/PECP) incorporated in the shelter
- CCTV cameras – generally mounted on posts.
- Passenger Information Display (PID) – generally mounted on posts.
- Public Address system (PA) – generally mounted on posts.
- Ticket Vending Machine (TVM) – floor mounted.
- Ticket Validators– generally mounted on posts.

The schematic design has been prepared for the following elements:

- Equipment pole footings
- Bench and shelter foundations
- Platform edge footings
- Shelter above ground structure

Tram stop lighting is to be developed as part of the system wide lighting except for illumination incorporated into the tram stop shelters. This is to be considered as part of detailed design.

The physical limit of tram stops, for the purposes of this stage of the design, are considered to begin and end at the foot of each ramp located at the ends of the platforms. Crossings are located outside of this scope and shall form part of the public realm design.

Tram stop Equipment Cabinets are to be located outside of this area, away from the tram stop platforms themselves and have been incorporated into the tram stop site plans. Tram stop duct banks and inspection chambers tie-in has been design in coordination with these.

2.3 Project Documents

Drawings

ETYN-SEF-XXX-02-DR-A-0006 - Tram Stops Location Plan

ETYN-SEF-4XX-02-DR-A-1000 - Balfour Street Tram Stop Location Plan

ETYN-SEF-4XX-02-DR-A-0010 - Balfour Street Tram Stop Site Plan & GA Plan

ETYN-SEF-4XX-02-DR-A-0011 - Balfour Street Tram Stop GA Sections & Elevations

ETYN-SEF-4XX-02-DR-A-0012 - Balfour Street Tram Stop Ducting & Drainage Plan

ETYN-SEF-XXX-02-DR-S-0001 - Tram Stops Structures & Foundations Sheet 1 of 2

ETYN-SEF-XXX-02-DR-S-0002 - Tram Stops Structures & Foundations Sheet 2 of 2

3 DESIGN BASELINE

3.1 Location of Works

This Design Statement relates to the Balfour Street Tram Stop. The Location Plan for this Prior Approval application is reproduced below.

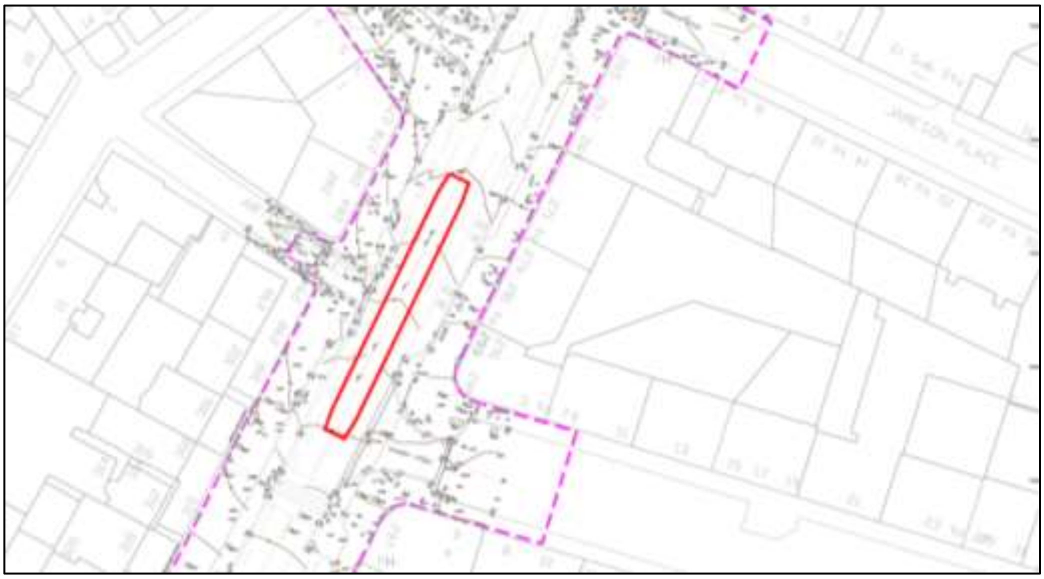

Figure 1: Balfour Street tram stop location plan

Balfour Street tram stop is located on Leith Walk, at the intersection with Balfour Street. It is an island tram stop and follows the gradient of the road at this point (approximately 2.5% max sloping down towards the north). The tram stop will occupy the central reservation of the street.

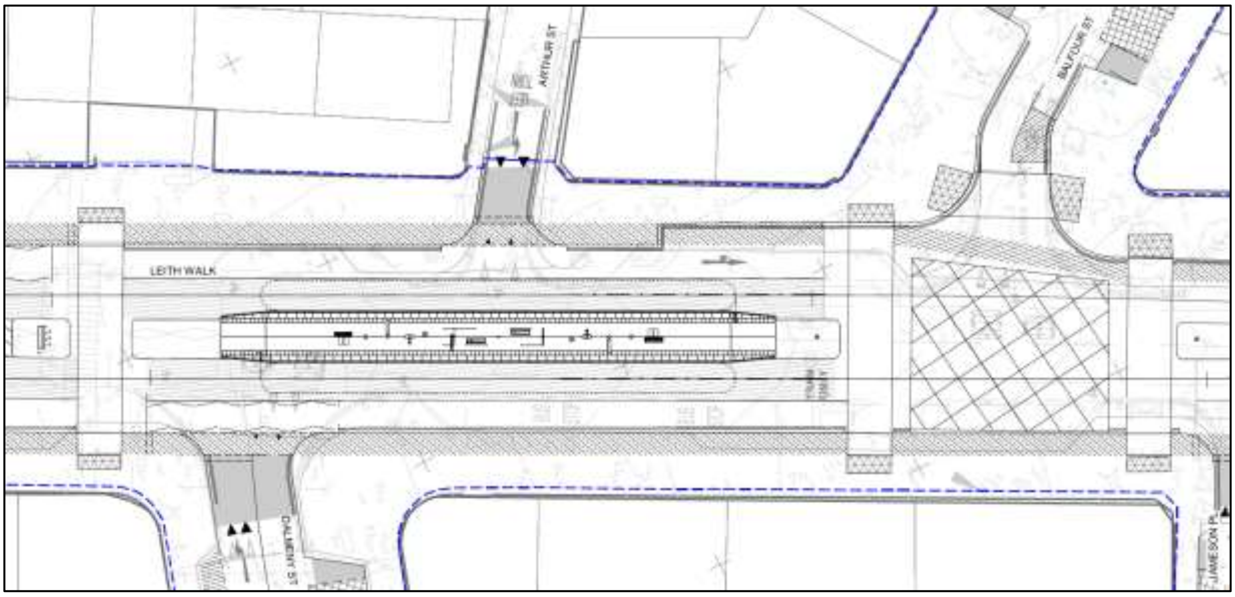

Figure 2: Balfour Street tram stop site plan

The TEC is located to the southwest of the tram stop, immediately adjacent to the platform crossing.

3.2 Design requirements, process and validation

Design requirements have been derived from the Employer's Requirements specification S 2005.11 Tram stops and other, related performance specifications. The key requirements consist of:

- Geometric requirements for platforms, minimum dimensions and maximum gradients.
- Tram stop architecture to match that of the existing tram stops and be consistent with the overall design aspirations. This is particularly relevant for the tram stop shelters.
- Platform finishes, and in particular paving.
- Tram stop furniture and equipment
- Setting out requirements for CCTVs
- Setting out requirements for PA speakers and induction loops
- Ducting and TEC
- Drainage
- Lighting
- Specific requirements for Newhaven and Foot of the Walk tram stops

Design process and validation at developed design stage has followed the process indicated below:

- Consolidation of employer's requirements
- Recompilation of stakeholder's comments to ECI stage document and the DD DBS
- Ongoing identification of areas where additional site investigation is required.
- Development of proposals based on the previous inputs
- Coordination with the interfaces:
    - Track works
    - Drainage
    - Ducting and Cabling
    - OLE

    - Earthing and bonding
- Finalisation and internal check (QA)
- Submit to SFN for review
- Following any changes during the review process, design is submitted to Employer for acceptance.

3.3 Key stakeholder identification and necessary consents

The following key stakeholders for tram stop design have been identified:

- The general public, as potential users of the tram itself and as those affected by execution of the works (drivers, pedestrians, neighbours, businesses).
- The Employer (CEC).
- Authorities having jurisdiction on matters of approvals (CEC planning department, utilities).
- Tram operating company.

3.3.1 Prior Approval

The tram has been granted consent through the Edinburgh Tram (Line 1) Act and the Edinburgh Tram (Line 2) Act ("the Acts"), which received Royal Assent in 2006. The tram line from Edinburgh Airport to York Place was completed in 2014. On 14 March 2019 the City of Edinburgh Council voted to extend the tram from York Place to Newhaven and this prior approval application forms part of the works required to implement the approved tram route.

The Planning Statement submitted in support of this application provides a detailed planning history and a thorough assessment of the proposed development within context of the relevant legislation and policy.

3.4 Interface and constraints

Tram stops have interfaces with the following disciplines:

Track Alignment: The track alignment will define the geometry of the platforms. Track alignment provides the setting out point for the tram stop, the elevation (Z) and gradient. The track geometry will also constrain the platform setting out in compliance with:

- Kinetic envelope and construction tolerances
- Stepping distance from the platform edge to the tram vehicle based on latest CAF documentation and UK tram guidance / Rail Vehicle Accessibility (Non-Interoperable Rail System) Regulations 2010.

Public Realm landscaping design: tie-in with proposed public realm design, pedestrian crossings, footpaths, cycle lands, kerbs etc.

Geotechnics: The geotechnical conditions will govern the foundation design of the tram stops shelters as well as footings for lighting and similar posts. A profile of the ground conditions beneath proposed tram stops and associated lighting columns will be provided along with allowable bearing capacities and expected settlement behaviour at each location.

The paving design at tram stops also assumes a certain bearing capacity which will need to be confirmed in situ during construction.

OLE: The OLE pole setting out has been coordinated with the tram stop layout, typically locating two OLE poles symmetrically on the platform. The OLE pole footings are currently designed to be superficial, but an interface will therefore exist with any duct banks and drainage infrastructure located below the platform.

Duct banks: The duct banks will need to coordinate with OLE, shelter and equipment footings on the platform. It will also need to coordinate with platform drainage. Duct banks and inspection chambers are set out in accordance with needs of tram stop equipment.

Tram stop lighting: lighting design will influence the requirement for cable ducting and manholes. Tram stop lighting is to be integrated in OLE poles and shelter design to reduce platform clutter. Platform lighting is being developed as part of the street lighting design. Shelter lighting is to be developed at detail design. Ducting has been provided for tram stop lighting.

Systems: equipment designed and installed by the Systems Subcontractor on the tram stop conditions the position of equipment mounting posts, ducts and manholes.

Tram stop equipment, including Parkeon related equipment (TVMs, validators) have been coordinated to schematic design level. They have been modelled in 3D for initial spatial coordination.

Constraints:

- Maximum distance from platform edge to tram door entry is 75mm (horizontal) and 50mm (vertical)
- Threshold levels of access to existing properties that are to be maintained. Minimum slope away from the properties for drainage.
- Platform ends and rear are to tie into public realm landscaping design.

4 MAINTAINABILITY REQUIREMENTS

All new installations shall be able to be maintained in line with existing maintenance procedures as per S320.3. The maintenance arrangements, tools and equipment shall be considered to ensure alignment with ETN.

Requirements are to include:

- Maintenance of shelter glazing, cladding and roof including drainage.
- Maintenance of platform surfaces including slot drain (in coordination with any drainage specific maintenance which should be consulted under the corresponding discipline).
- Maintenance of furniture – benches and litter bins.
- Maintenance of buried infrastructure such as cabling and ducting, induction loops and earth bar. Inspection chambers to be located for this purpose.

5 TRAMSTOP DESIGN

5.1.1 Position, Layout and Geometry.

Tram stops are set out on plan by matching the central axis of the proposed tram stops as they appear on the client's Permanent Works drawings.

Platforms are to be 42m long (40m plus 2m overrun) and a minimum 4.0m wide for island platforms and 3.0m wide for side platforms. The actual width of island platforms is determined by the track geometry and the distance from the track axis to the platform edge.

Platforms are to be provided with ramps at each end (maximum 5% slope). Ramps taper on plan, being approximately 400mm narrower on each side at the bottom of the ramp. At this stage of the design, integration with the proposed public realm design assumes that 4m ramps at maximum slope will be sufficient to achieve the level required at platform crossings. This is to be confirmed at the next design stage when integration with the proposed public realm design will be complete. If necessary, ramps can be extended in order to reach lower proposed levels.

The platforms are provided with a gradient along their length that matches the adjacent track geometry. Platforms slope down towards the north (a maximum of 2.5%). Platform surfaces are also provided with a transversal gradient of 2.5% away from the platform edge, i.e. towards the centre of island platforms and towards the rear of side platforms. The platform edge coping itself is 600mm wide and is not given a transversal gradient.

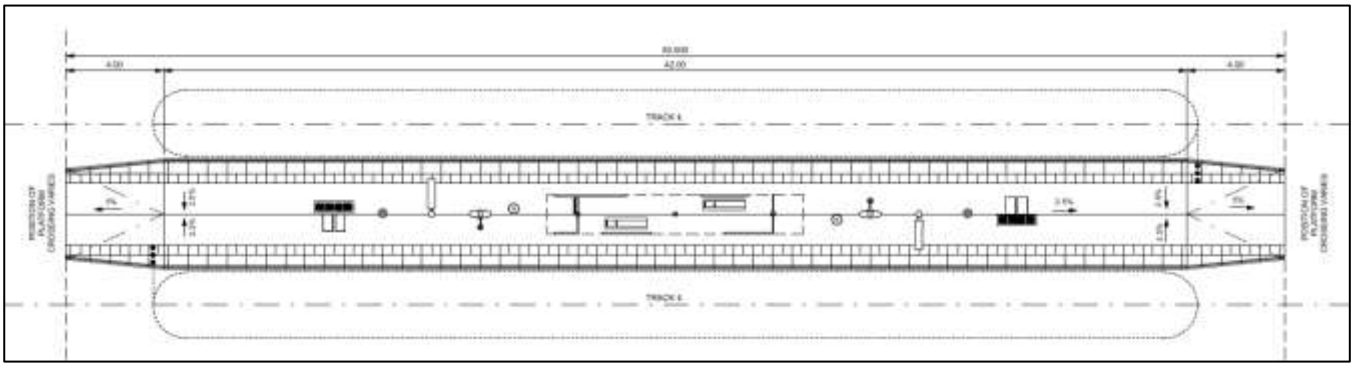

Figure 3: Typical geometry of island platforms

The layout of elements on the platform is according to the following basic criteria: shelters are placed on the central axis. Equipment and furniture (each according to their own requirements as described below) are positioned at various distances from the centre of the platform. On Island platforms, each half is symmetrical about the central axis. Side platforms vary according to specific requirements at each location.

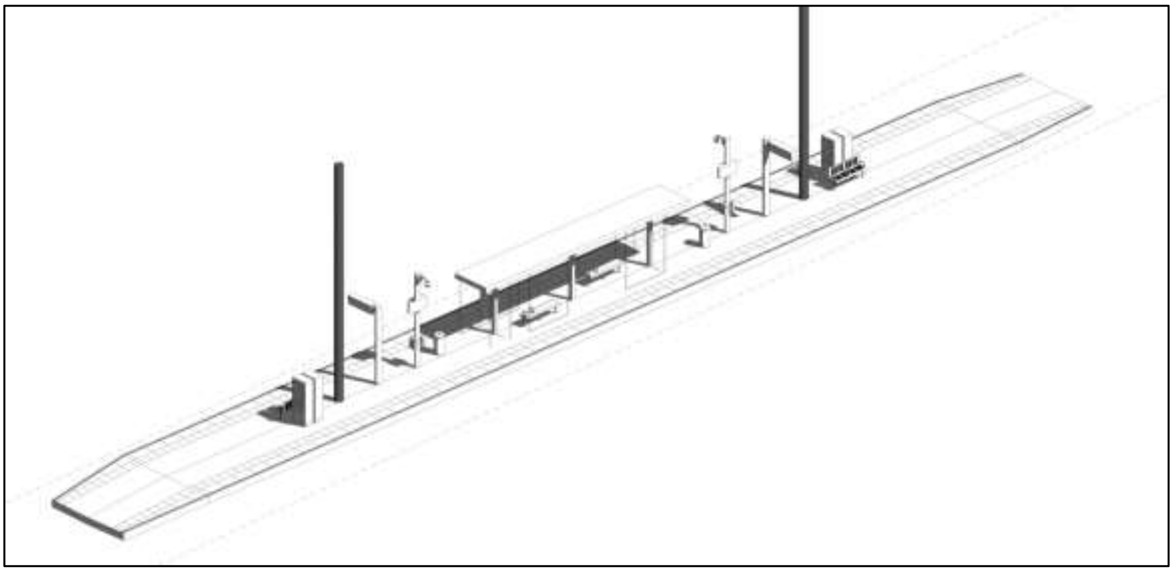

Figure 4: typical composition of island tram stops (axonometric)

The height from top of rail to the platform edge is to comply with the recommendations of UK Tram guidance, Point 5 Tram stops, Platform Clearances. This guidance makes reference to the Rail Vehicle Accessibility (Non-Interoperable Rail System) Regulations 2010. The regulations state that no ramp or lift is required “where the gap between the edge of the door sill of the wheelchair-compatible doorway and the platform, or stop, is not more than 75 millimetres measured horizontally and not more than 50 millimetres measured vertically.”

Although the regulation only stipulates for the wheelchair compatible doorway, it has been considered prudent to apply to all tram doors stepping distances.

Drawing Q.22.93.131 in Volume 3 Appendices\Appendix Z- CAF Tram Vehicle Information, defines the stepping distance between the platform and the vehicle. Other drawings such as Q.22.93.130 and Q.22.93.132 also define the stepping distance taking slightly different data to analyse the problem and obtaining very similar results.

This drawing defines the distance between the platform and the vehicle in three situations, assuming a distance from the track axis to the edge of the platform of 1,438 mm:

- Minimum distance between platform and vehicle: 23.5 mm
- Distance when the train is running at 35 km/h: 4.5 mm
- Nominal position: 48.5 mm

Taking into account that the difference between the nominal position and the position of maximum proximity is 25 mm, it may be deduced that the distance of **maximum separation** would be 73.5 mm:

- Maximum distance between platform and vehicle: 73.5 mm.

While this analysis takes into account construction tolerances and wear of the track, it does not consider any construction tolerance for the platform. It is important to note that the Rail Vehicle Accessibility Regulations 2010 state that the dimension of 75 mm is the maximum that must be maintained over the life of the system. Therefore, the distance between the track and the platform is constrained by the maximum distance, 73.5 mm, that is very close to the limit, and the minimum distance (4.5 mm), which necessitates a very tight construction tolerance.

The table below shows the distances described above for a distance between the edge of the platform and the track axis of 1,438 mm. The figures in the table describe the situation without can't and with 1% of can't to facilitate drainage in stops with lateral and central platforms. The following two columns show the construction tolerances of the platform, away from the track and closer to the track. Finally, the maximum and minimum distance between the vehicle and the platform assuming a construction error of 5 mm, which is relatively low for civil works (i.e. a demanding degree of accuracy). It is worth noting that without can't and with can't and lateral platform **there may be a collision between the vehicle and the platform**. Maximum distances overpass the limit of 75 mm in all the cases:

Table 1 Stepping distances track axis at 1,438mm from the platform

	DISTANCE BETWEEN EDGE OF PLATFORM AND TRACK AXIS	DISTANCES BETWEEN VEHICLE AND EDGE OF PLATFORM				CONSTRUCTION TOLERANCE		MIN AND MAX DISTANCES INCLUDING CONSTRUCTION ERRORS	
		A. Distance when train running at 35 km/h	B. Minimum distance between static vehicle and platform	C. Nominal position	D. Maximum distance between static vehicle and platform	Platform construction tolerance (away from the track)	Platform construction tolerance (closer to the track)	Maximum distance between static vehicle and platform with a construction error of 5 mm away from the track (MAX=75 mm)	Distance when train running at 35 km/h with a construction error of 5 mm towards the track
No cant	1438	4,5	23,5	48,5	73,5	1,5	4,5	78,5	-0,5
Cant 1%- Lateral platform	1438	1,5	20,5	45,5	70,5	4,5	1,5	75,5	-3,5
Cant 1%- Central platform	1438	7,5	26,5	51,5	76,5	-1,5	7,5	81,5	2,5

With the aim to avoid the possibility of a collision between the vehicle and the platform, the following table shows the same values for a distance between the platform and the track axis of **1,442 mm**. The risk of collision is mitigated, although the maximum distance increases by 4 mm, exceeding the limit stated in the normative by 10.5 mm in the most unfavourable case:

Table 2 Stepping distances track axis at 1,442mm from the platform

	DISTANCE BETWEEN EDGE OF PLATFORM AND TRACK AXIS	DISTANCES BETWEEN VEHICLE AND EDGE OF PLATFORM				CONSTRUCTION TOLERANCE		MIN AND MAX DISTANCES INCLUDING CONSTRUCTION ERRORS	
		A. Distance when train running at 35 km/h	B. Minimum distance between static vehicle and platform	C. Nominal position	D. Maximum distance between static vehicle and platform	Platform construction tolerance (away from the track)	Platform construction tolerance (closer to the track)	Maximum distance between static vehicle and platform with a construction error of 5 mm away from the track (MAX=75 mm)	Distance when train running at 35 km/h with a construction error of 5 mm towards the track
No cant	1442	8,5	27,5	52,5	77,5	-2,5	8,5	82,5	3,5
Cant 1%- Lateral platform	1442	5,5	24,5	49,5	74,5	0,5	5,5	79,5	0,5
Cant 1%- Central platform	1442	11,5	30,5	55,5	80,5	-5,5	11,5	85,5	6,5

The figure below graphically indicates the distances resulting from scenarios A, B and C without considering cant.

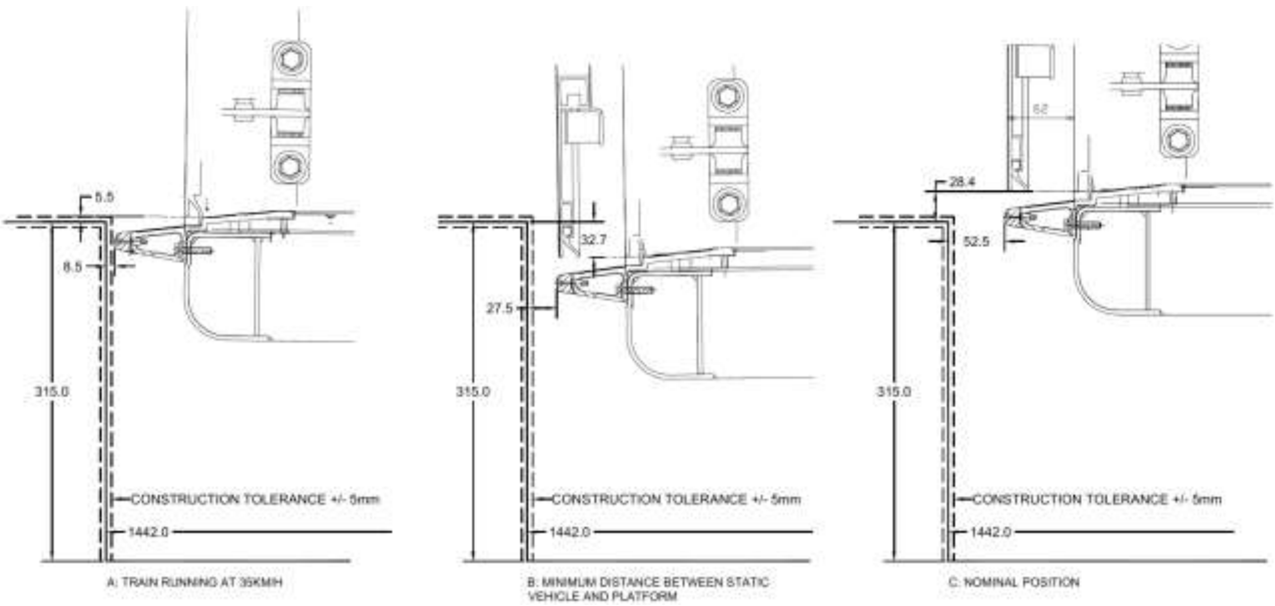

Figure 5: Stepping distance analysis

Therefore, the proposal is to increase the distance between the platform and the track axis to 1,442 mm, as this decision reduces the chances of the vehicle touching the platform. The operator will check the maximum distance between vehicle and platform during the service life of the works, and will implement corrective measures in case this distance overpasses the limit of 75 mm.

The preceding analysis considers various scenarios (three indicated on CAF drawing Q.22.93.131 and a fourth “D: maximum distance between static vehicle and platform”). These scenarios allow for wheel flange wear, rail wear and suspension as well as the tram moving at 35km/h. The analysis also considers the construction tolerances of the platform. Whilst it is possible to remain within the limit of a horizontal stepping distance of 75mm considering either wear over time or construction tolerance of the platform, it is impossible to comply with both. As a compromise, the proposed distance (1,442mm) and a construction tolerance of +/-5mm complies under all scenarios except for scenario “D.”

Concerning the vertical distance between the floor of the vehicle and the platform, for a height of the platform of 300 mm the lowest position of the vehicle is 18 mm below the platform level and the nominal position is 44 mm above platform level. Guidance on

Tramways states that differences in height between tram floor and platforms must not exceed 50 mm. Increasing the height of the platform to 315 mm leads to the following results:

Table 3 Vertical stepping distances TOR to platform 315mm nominal

	Height of the platform from TOR	From Platform level to lowest position of the vehicle	From platform level to vehicle nominal position
Nominal heigth of platform	315	-33	29
Platform level +10 mm	325	-43	19
Platform level -10 mm	305	-23	39
Platform level +15 mm	330	-48	19
Platform level -15 mm	300	-18	44

The proposed height of 315 mm allows for a construction tolerance of the platform of 10mm or even 15mm keeping the maximum distance between platform and floor of the vehicle inside the limits stated by the regulations.

5.1.2 Platform Construction and Materials

Tram stop paving finish materials are determined by the client's tram stop specification and is particular to each location. Details of the Balfour Street specifications are provided in Appendix 1. Bedding materials for each paving has also been stipulated by the cited specification. Sub base and sub grade materials are proposed as follows.

Sub base and sub grade layers are to conform to Specification for Highways Works (SHW) CD239 Footway and cycleway pavement design. Sub grade material shall have a minimum California Bearing Ratio (CBR) of 2.5%. Where sub grade does not comply with this, ground improvement must be carried out. Sub grade shall be compacted to clause 802 paragraph 5 of the SWH.

Sub grade shall be either Type 1 or Type 3 as specified in clauses 803 and 805 of the SHW, respectively. Sub base layers shall be compacted in compliance with clause 802.

All material within 450mm of the surface shall be non-frost susceptible as defined in clause 801 of the SHW.

The typical details below show main paving build-up and platform edge coping details for all tram stops with prefabricated concrete paving (i.e. McDonald, Balfour, Port of Leith, Ocean Terminal, Newhaven). All tram stops are to be paved with natural stone in accordance with the tram stops performance specification.

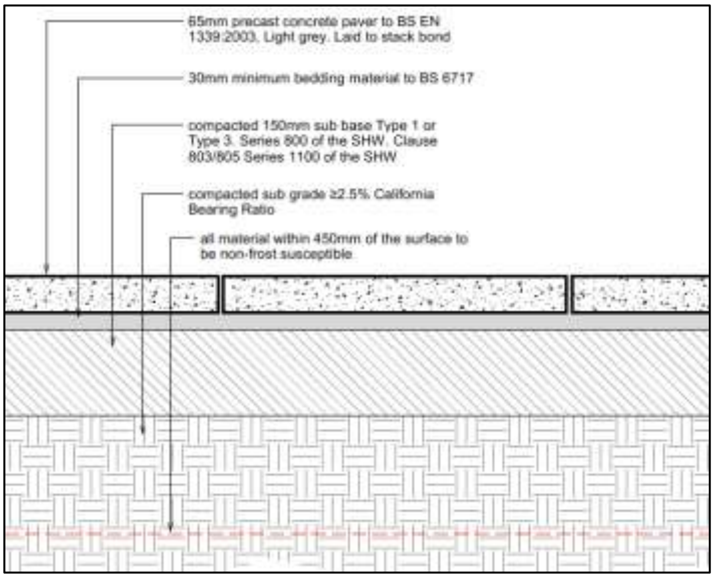

Figure 6: Main platform paving, typical build up

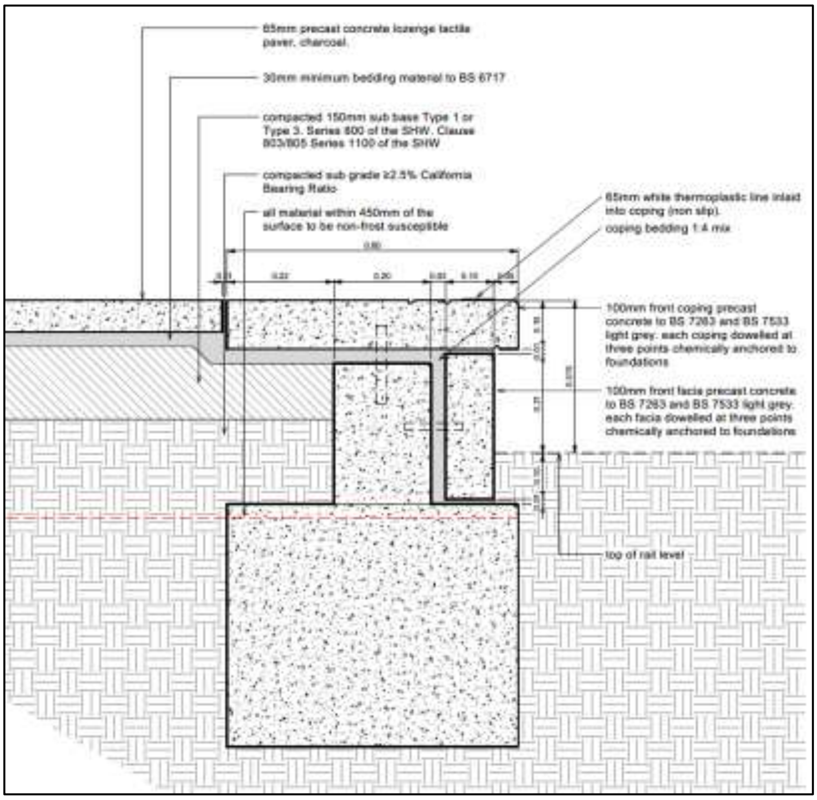

Figure 7: Platform edge coping typical detail

Gradients are not shown on the details for clarity.

At detailed design stage, details will be completed for rear copings, ramps, slot drainage channels, inspections chambers, and other locations as required.

Outline design for platform edge foundations can be found in the following section.

5.1.3 Platform Structures and Footings

For the structures of the shelters and poles located at the tram stops steel members are designed. The poles are hollow circular cross-section elements with defined heights. On the other hand, the shelters columns and the central beam are built of tubular cross-section profiles. The rest of structural elements of shelter are steel open cross-section profiles: cantilevers members joined to central beam with variable depth where continuous beams are supported along the roof shelter.

However, pending to receive information on the structure of the shelters of the existing tram stops, the structure will be detailed in the detailed design.

For foundations, concrete footings are designed. Some of the elements have reinforced concrete foundations class C35/45 and with reinforcing steel meshes of steel grade B500B in accordance with BS 4449 and BS EN 1992-1-1. The rest of the foundations are built with C25/30 mass concrete stablished in BS EN 1992-1-1. The different foundations are the following:

Double shelter: the double shelter footing is a 9500x1800x300mm reinforced concrete slab over a minimum of 75mm thick blinding concrete ST1. The foundation is reinforced with a top mesh of Ø10/200mm and a bottom mesh of Ø12/100mm. The steel columns are joined to foundation with a 425x425x10mm baseplate of steel grade S235 with 4xM16 HILTI HIT-HY 200-A + HIT-Z with 200mm of embedment depth.

Bin: the bin footing is a 700x700x350mm mass concrete element with a square plinth of 400x400mm below bin infilled up to finished floor level. The bin is joined to foundation with 4xM12 HILTI HIT-HY 200-A + HIT-Z with 150mm of embedment depth in foundation (below the plinth).

Passenger Information Display (PID): the PID footing is a 800x800x800mm mass concrete element. The PID column is joined to foundation a 425x425x10mm baseplate of steel grade S235 with 4xM16 HILTI HIT-HY 200-A + HIT-Z with 200mm of embedment depth in foundation.

Ticket Vending Machine (TVM): the TVM footing is a 900x700x300mm reinforced concrete slab over a minimum of 75mm thick blinding concrete ST1. The foundation is reinforced with a top mesh of Ø10/200mm and a bottom mesh of Ø12/100mm. The TVM is joined to foundation with 4xM16 HILTI HIT-HY 200-A + HIT-0Z with 170mm of embedment depth.

Platform bench: the platform bench footing is a 2000x800x300mm reinforced concrete slab over a minimum of 75mm thick blinding concrete ST1. The foundation is reinforced with a top mesh of Ø10/200mm and a bottom mesh of Ø12/100mm. The steel columns are joined to foundation with a 250x250x10mm baseplate of steel grade S235 with 4xM12 HILTI HIT-HY 200-A + HIT-0Z with 150mm of embedment depth.

Integrated bench: the foundation of the integrated bench is the same that shelter foundation. This bench is joined to foundation with a 250x250x10mm baseplate of steel grade S235 with 4xM12 HILTI HIT-HY 200-A + HIT-0Z with 150mm of embedment depth.

CCTV, Public Address, Tram stop Sign and Validators Pole: the pole footing is a 800x800x800mm mass concrete element. The pole column is directly embedded to foundation with concrete sleeve cast into base and later sleeve is filled with compacted sand.

Platform edge coping: the platform edge coping footing is a 500x500mm mass concrete linear element with a concrete wall of 200mm of thick and variable height up to precast coping.

Tram stop Equipment Cabinet (TEC): the TEC footing is a 2200x850x350mm reinforced concrete slab over a 2400x1030x225mm compacted hard core (blinding with sand). The foundation is reinforced with a top mesh of Ø10/200mm and a bottom mesh of Ø12/100mm. The TEC is joined to foundation with 6xM16 fixing bolts with 225mm of embedment depth with 50mm above concrete surfaces using “Kemfix” chemical adhesive.

5.1.4 Crossings

Platform crossings are to be provided at all tram stops. Typically, they are immediately adjacent to the foot of the platform ramps. Crossings are part of the public realm design and therefore form an interface with tram stops. At DD stage, crossings have been shown indicatively. Final design and coordination with tram stops, especially regarding levels, will be completed at detailed design stage.

5.1.5 Shelters

The double bay shelter contains two benches and are to be installed on island platforms (five tram stops with this configuration).

Shelter design is to match as closely as possible the existing shelters on phase one.

Figure 8: Existing shelter at Princes Street tram stop

The shelter is composed of steel columns and roof structure, clad in satin finish stainless steel, curved panels. To be confirmed at detailed design stage, the cladding is expected to be for marine environments Grade 1.4401 satin polished as defined in EN 10088-4 (this is equivalent to AISI 316). The walls are constructed in stainless steel framed glazing. The glazed walls are to provide clear field of view of incoming trams for passengers waiting within the shelter. Shelters incorporate a number of elements that require a degree of coordination. These are listed below:

Shelter drainage: pending detail design, rainwater is proposed to be collected from the roof surface via a downpipe encased in the column cladding. A minimum of two downpipes will be provided in order to reduce the risk of blockage from leaves or litter. From this point the rainwater is proposed to drain directly to the platform drain.

Shelter lighting: the shelter roof is to incorporate a number of downlights in order to comply with the levels of illumination required (50 lux). Detailed design of the lighting and its integration in the shelter roof is to be developed at detailed design stage. At this stage, platform ducting and chambers has taken account of this requirement.

Figure 9: Shelter lighting (existing design)

Public Address speakers: as can be seen in the figure above, the roof structure also incorporates PA speakers. The Systems team shall provide the shelter designers with spatial requirements in order to coordinate these items at detail design stage.

Passenger Help Point: combined passenger help points, and passenger emergency call points are designed and installed by the Systems team. Detailed spatial and conduit requirements will be provided by the Systems team in order to coordinate this item with the detailed shelter design. The PHP/PECP is recessed into the end column cladding at all shelters. The proposed position of this element has been indicated on the DD tram stop drawings. This location is required to be within the field of vision of at least one CCTV camera.

Figure 10: PHP/PECP integrated in shelter (existing design)

Feedback from the Systems team suggests that phase one PHP/PECPs have suffered a degree of failure due to ingress of rainwater. This is thought to be caused by the design of the speaker and/or microphone cover rather than how the element is integrated in the shelter column. The Systems team will propose mitigation for this known design issue.

The DD tram stop design incorporates platform ducting, chambers and conduits for this element.

Information Panel: 1,119mm x 717mm weatherproof information panels shall be installed within the shelter in locations that match the exiting network.

Figure 11: Information Panel integrated in shelter (existing design)

Induction loop: an induction loop is to be embedded in the paving at shelters, located within the bedding layer (TBC). A schematic layout is provided for this in the DD tram stop plans as well as inspection chamber and connection to the TEC.

Feedback from the Systems Team suggests that existing phase one induction loops might not be effective due to the location of metallic elements within the shelter. As the design moves to detailed stage, any mitigating measures proposed by the Systems team shall be incorporated into the design.

5.1.6 Equipment

Apart from equipment integrated in the shelter as described in the previous section (PA speakers, PHP/PECP, Induction loop), the following equipment is to be integrated at each tram stop:

Passenger Information Display. These are located towards the end of each platform (towards the rear of a stationary tram vehicle). The PID is to be within the field of vision of a CCTV camera mounted on the platform. The current DD design has proposed positions of all PIDs as well as connection to platform duct banks.

Figure 12: PID (existing design)

Ticket Vending Machines: these are located at platform ends in the number stipulated by the performance specification. They are orientated such that queuing passengers do not block the platform. Tramway Principles & Guidance, First Edition, January 2018, stipulates that “Platform width should give adequate unobstructed space for passengers boarding and alighting and should consider pedestrian movements along the platform and the likely accumulations of waiting passengers. Consideration should be given to congestion likely to be caused adjacent to ticket vending machines and beneath shelters.

“The minimum width between the tramway edge of the platform and any structure on the platform, except for the roofs of shelters, should not be less than 1500 mm.”

TVMs are typically grouped in twos. The base is to incorporate conduits for the necessary cable connections. This is to be coordinated with Parkeon.

Figure 13: TVM (existing design)

CCTV: cameras are typically pole mounted and are positioned in order to provide field of view to the TVMs, the PID and the PHP. The systems team are concurrently carrying out an analysis of FoV of each camera as proposed in this DD. A check will need to be made that the shelters, OLE, lighting or any other element do not impede coverage of the CCTV.

Figure 14: CCTV camera (existing design)

The current design has proposed duct banks and inspection chambers for connection of these devices.

Public Address and Stop Sign: Public address speakers are integrated into the tram stop sign. These elements are mounted on the same poles as the CCTV camera.

Figure 15: PA speakers integrated in tram stop sign (existing design)

Duct banks and inspection chamber have been provided at this stage for connection of these device to the TEC.

Validators: ticket validators are located on CCTV poles in the quantities prescribed by the performance specification. Validators are orientated perpendicular to the track direction thus avoiding blockage of the platform by queuing passengers.

Duct banks and chamber have been provided on the platform for connecting these devices to the TEC. This equipment will be coordinated for final detailing with Parkeon.

Figure 16: Validators (existing design)

5.1.7 Furniture

Seating: freestanding benches are located along the platform and within the shelters. Benches are to match a closely as possible those of phase one and are be anchored to concrete footings constructed below the platform. Benches are fabricated in stainless steel. Pending confirmation at detailed design stage, this is expected to be grade 1.4401 as defined in EN 10088-4, satin polished stainless steel.

Benches within shelters have no back rests.

Figure 17: Seating (existing design)

Bins: litter bins are located along the platform in the quantity prescribed by the performance specification. The design of the litter bins is to match as closely as possible those installed on phase one. The bins are to be fabricated in satin polished stainless-steel grade 1.4301 EN 10088-4. Bins are to be anchored to concrete footings constructed below the platform.

Figure 18: Litter bins (existing design)

5.1.8 Ducting, Inspection Chambers and TEC

Developed design stage tram stops indicate a schematic layout for platform ducting and related inspection chambers. At each tram stop, the position and orientation of the TEC has been proposed. This is required to be located away from the platform but within 90m (cable run) of the equipment that is furthest away.

As a general design criteria, the TECs are placed in the central reservation of the street, immediately following the platform crossing. The placement of the TEC, considering the cabinet doors sweep, does not impede the flow of pedestrians or generate risk for those persons carrying out maintenance tasks on the cabinet.

Figure 19: TEC cabinet (existing design)

The TEC is to be mounted on a concrete plinth provided with conduits for connection with the UTX or "turning chamber." Final details and setting out of this base are to be developed at the next design stage, although fabrication drawings have been provided for this element.

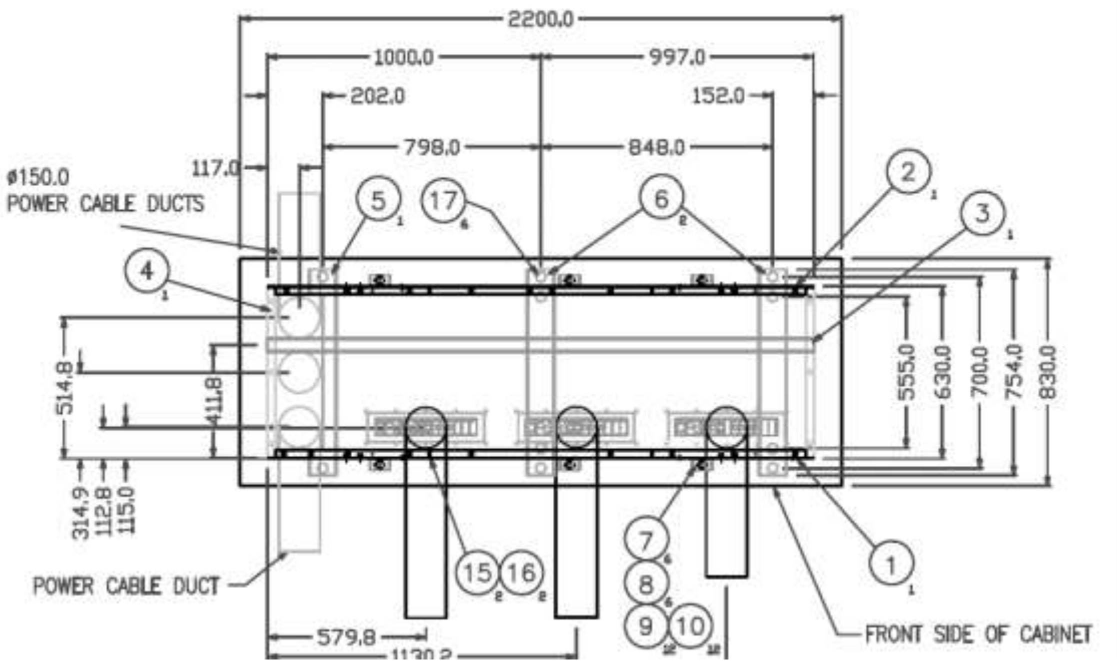

Figure 20: TEC plinth layout

Platform duct banks are provided at each stop that connect the TEC to each and every piece of equipment on the platform. A number of platform inspection chambers are placed along the platform. From these, conduits are provided to each pole or plinth on which equipment is mounted.

The coordination of duct banks and chambers with platform and system wide drainage is ongoing. It is expected that primary duct banks are to be constructed at some depth below drainage (as well as any footings and foundations required at platforms) whilst platform duct banks are constructed nearer to the surface.

As a general design criteria, drains and related access chambers are located on one side of the platform and duct banks on the opposite side of the platform in order to avoid clashes.

5.1.9 Platform and Shelter Drainage

Developed design for tram stops has proposed a schematic layout for platform and shelter drainage. This consists of a central channel on island platforms and side channel on side platforms which connect via an inspection chamber to the route wide drainage system.

Platform drains are based on ACO multidrain MD100DS bickslot with 500x100mm access units placed at the start and end of each drain.

Figure 21: Proposed platform slot drain

Rodding eye access is provided to the buried 150mm pipe. This pipe is provided with a minimum 1:40 fall.

Coordination with platform ducts and other, below ground infrastructure at tram stops is ongoing. This is to be completed at detail design stage.

5.1.10 Lighting

Lighting at tram stops is to comply with the minimum illumination levels as indicated in the tram stop specification. This is being developed in conjunction with street lighting design. Where additional platform lighting is required (i.e. where street lighting does not already comply with the minimum lux) luminaires are expected to be placed on the OLE poles.

At shelters, downlights are to be integrated into the roof. Details for integration of these elements in the shelter design is to be finalised at detailed design stage.

5.1.11 OLE

OLE poles are located on most tram stops. As a general criteria, at island tram stops two OLE poles are located symmetrically to the platform centreline. The span between poles has been defined by this discipline.

Pole footings are currently designed as superficial foundations. This permits other infrastructure to be located below this level, such as primary duct banks.

Figure 22: OLE pole (existing design)

6 CONCLUSIONS

This phase of the project has developed the design of tram stops to schematic level. Most significantly, the coordination of civil works at tram stops has begun with systems design, drainage, ducting and cabling and OLE. This coordination will be finalised in the detail design stage.

Balfour Street tram stop will provide a high-quality addition to the streetscape and will aid in the facilitation of the Edinburgh Tram Network.

7 APPENDIX 1 EQUIPTMENT, SIGNAGES, FINISHES AND MATERIAL SCHEDULES

7.1.1 Equipment, signage and furniture schedule

Equipment (designed and installed by Systems team). TVM + validators by Parkeon	**No.**	**Signage and Furniture**	**No.**
PHP/PECP	2	Stop name sign (northbound is wall mounted)	4
CCTV cameras (northbound is wall mounted)	2	System logo sign (pending location)	0
PID (northbound is wall mounted)	2	Information panel (pending location)	0
PA speakers (northbound is wall mounted)	4	Platform seating	4
TVM	4	Litter bins	4
Ticket Validators (northbound is wall mounted)	4		

7.1.2 Finishes schedule

Element	Module size (including joint)	Material	Bedding
Platform edge coping	800 x 600 x 100mm	Caithness granite sawn flamed finish to BS EN 1341	1:4 mix (and dowel fixed)
Visible strip	65mm wide	White thermoplastic non-slip strip	Inlaid in platform edge coping
Platform edge upstand coping stone	800 x 150 x 300mm	Caithness granite sawn flamed finish to BS EN 1341	1:4 mix (and dowel fixed)
Platform tactile strip	400 x 400 x 65mm	Precast concrete charcoal lozenge tactile paving	To BS 6717
Main paving	300 x 450 x 65mm minimum	Caithness granite sawn flamed finish to BS EN 1341	To BS 6717
Rear coping	300 x 800 x 65mm (width varies on to adapt to façade building line)	Caithness granite sawn flamed finish to BS EN 1341	1:4 mix

8 APPENDIX 2 ABBREVIATIONS

BIM	Building Information Modelling
CCTV	Closed Circuit Television
CEC	City of Edinburgh Council
DBS	Design Basis Statement
DMP	Design Management Plan
ECI	Early Contractor Involvement
ER	Employer's Requirements
LOD	Level of Detail
OLE	Overhead Line Equipment
PA	Public Address
PHP/PECP	Passenger help / passenger emergency call points
PID	Passenger Information Display
PRM	Persons of Reduced Mobility
SFN	Sacyr Farrans Neopul
SPC	Swept Path Contractor
TICZ	Tram Infrastructure Clearance Zone
TVM	Ticket Vending Machine

9 APPENDIX 3 REFERENCES

9.1 Design Codes and Standards

- Railways Safety Publication 2 – Guidance on Tramways, issued by the Office of Rail and Road (ORR)
- Disability Discrimination Act requirements. Note that the Disability Discrimination Act 1995 has largely been substituted by the Equality Act 2010 which shall be referred to instead.
- The Department for Transport Inclusive Mobility Guide to Best Practice on Access on Pedestrian and Transport Infrastructure
- The Building (Scotland) Regulations (Part 4 Safety)
- The requirements of the Tram Design Manual.
- The Building (Scotland) Regulations (Part 1 Structure) for design of tram stop structures where applicable.
- The Rail Vehicle Accessibility (Non-Interoperable Rail System) Regulations 2010.
- BS EN 60529 Specification for Degrees of Protection Provided by Enclosures – for specification of IP level of tram stop equipment cabinets.
- Construction (Design and Management) Regulations 2015.
- DETR 1998 'Guidelines on the use of Tactile Paving Surfaces.'
- BS EN 1993-1-4 General rules -Supplementary rules for stainless steels
- BS EN 10088-4 2009 Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes

9.2 Contract Document References

The following contract documents have formed references for the current tram stop design:

Vol. 3 Scope Document

Appendix A Performance Specifications

S 2005.11 Tram stops

S 2005.29 Closed Circuit Television

S 2005 07 Cabling and Ducting

S 2005.30 Public Address System

S 2005.31 Passenger Help Points

S 2005.33 Passenger Information Display System

S 2005.40 Integrated Fare Collection

Appendix I Clients Design Drawings

Permanent Works

Landscaping

Appendix Z- CAF Tram Vehicle Information

Vol. 4 Site Information Directory

Appendix H As-Built Information for Existing Network. S 2005.11 Tram stops.

Vol. 5 Reference Information

Appendix P tram stops. Exemplar tram stop reference documentation

Appendix L SDS design TQ014 Tram stops and S 2005.11 tram stops

Appendix J Foot of the Walk Tram stop Study

Appendix O Newhaven Terminus Study