



Chartered Structural Engineers

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## **Annex A1b**

**Model form of Approval  
in Principle for the design/  
assessment of bridges and  
other highway structures  
where UK National Standards  
(Non-Eurocodes) are used**

**Name of Project: Shaftesbury Theatre  
Name of Structure: Proposed Basement  
Extension  
Structure Ref No.: n/a**

### **1. HIGHWAY DETAILS**

#### **1.1 Type of highway**

Pedestrianised, future highway loading.

#### **1.2 Permitted traffic speed**

20mph

#### **1.3 Existing Restrictions**

None at present

### **2. SITE DETAILS**

#### **2.1 Obstacles crossed**

Not applicable

### **3. PROPOSED STRUCTURE**

#### **3.1 Description of structure and design working life**

A proposed new single storey basement will extend from the external elevation of Shaftesbury Theatre along two sides currently named Bloomsbury Street and High Holborn.

#### **3.2 Structural type**

A contiguous piled wall will form the perimeter of the proposed basement. This will be designed by a specialist consultant who will be appointed if/when planning permission is granted. Loadbearing piles will be installed within the perimeter of the basement. These will support a ground beam and pile cap arrangement upon which in-situ RC columns will be cast. In-situ RC primary beams will span between the columns. Secondary RC beams will span between the contiguous piled wall and the primary beam. An in-situ concrete slab will span between the secondary beams.

### 3.3 Foundation type

Bored cast in-situ reinforced concrete piles.

### 3.4 Span arrangements

Slab span- 1.44m

Secondary beam span- 5.75m

Primary beam span- 4.32m

Contiguous piles- 3.3m (propped cantilever)

Note: Spans will be shorter on the High Holborn elevation of the basement.

### 3.5 Articulation arrangements

The slab will be designed to span continuously over the secondary beams. The secondary beams will have a fixed connection to the contiguous piled wall and will be simply supported by the primary beam. The primary beam will be designed as simply supported.

### 3.6 Road restraint systems requirements

Not applicable

### 3.7 Proposed arrangements for future maintenance and inspection/Inspection for Assessment1

The soffit of the slab will be exposed concrete and accessible for visual inspection.

#### 3.7.1 Traffic management

Not applicable

#### 3.7.2 Arrangements for future maintenance and inspection of structure.

The soffit of the slab will be exposed concrete and accessible for visual inspection.

#### 3.7.3A Intrusive or further investigations proposed

Not applicable

### 3.8 Environment and sustainability

No proposals as of yet. More information will be available once contractor is appointed.

### 3.9 Durability. Materials and finishes/Materials strengths assumed and basis of assumptions<sup>1 4</sup>

Minimum proposed concrete strength C40. Reinforcement  $f_y = 500\text{N/mm}^2$ .

3.10 Risks and hazards considered for design, execution, maintenance and demolition.  
Consultation with and/or agreement from CDM co-ordinator <sup>5</sup>

Risks considered: Excavation close to an adjacent building, potential for high water table, localised ground movement during construction, safe operation of the venue during construction work. The risks and hazards involved with construction will be identified in task specific risk assessments and method statements. A basement impact assessment has been carried out and is appended.

3.11<sub>D</sub> Estimated cost of proposed structure, together with other structural forms considered (including where appropriate proprietary manufactured structure), and the reasons for their rejection (including comparative whole life costs with dates of estimates)

£2,762,256 including fit out.

Alternative construction methods considered were a “top down” gravity retaining wall solution, sheet piled solution and potential use of precast concrete to form the roof slab. The client on the project requires as much cost and programme certainty as possible therefore it was concluded that bored cast in-situ piles with in-situ concrete slabs were the most appropriate solution for this scheme.

3.12<sub>D</sub> Proposed arrangements for construction

3.12.1 Construction of structure

It is proposed to install the contiguous retaining wall and load bearing piles prior to excavating the basement. Temporary props to the retaining wall will be designed by the specialist pile design consultant who will provide an addendum to the document once appointed. Once piles are in place, pile caps and ground beams will be cast in-situ. The basement slab will then be cast followed by RC columns. Temporary formwork will be installed prior to casting of the ground floor/roof slab and beams. The temporary works designer will submit a separate temporary works AIP once appointed.

3.12.2 Traffic management

The roads surround Shaftesbury Theatre will be closed as part of the West End Project. The work to form the basement will coincide with the West End Project.

3.12.3 Service diversions

A full utilities survey has been carried out and multiple diversions are required. The services will be diverted into a zone outside the line of the basement. The utility diversions will be managed by Source who are a specialist in this field of work.

3.12.4 Interface with existing structures

The proposed basement is to be constructed alongside Shaftesbury Theatre. There is a Crossrail tunnel running below High Holborn, adjacent to the theatre. Crossrail have been consulted and the location of their asset has been identified. All work is to be carried out outside of the Crossrail exclusion zone.

3.13<sup>A</sup> Year of construction

Not applicable

3.14<sup>A</sup> Reason for assessment

Not applicable

3.15<sup>A</sup> Part of structure to be assessed

Not Applicable

**4. DESIGN/ASSESSMENT<sup>1</sup> CRITERIA**

4.1 Actions

4.1.1 Permanent actions

Slab dead load, road build up and paving

4.1.2 Snow, Wind and Thermal actions

Snow load as BS5400-2 . No wind Load.

4.1.3 Actions relating to normal traffic under AW regulations and C&U regulations <sup>6</sup>

HA loading.

4.1.4 Actions relating to General Order traffic under STGO regulations <sup>7</sup>

HB Loading (25 Units).

4.1.5 Footway or footbridge variable actions

10kN/m<sup>2</sup> general loading.

4.1.6 Actions relating to Special Order traffic, provision for exceptional abnormal indivisible loads including location of vehicle track on deck cross-section <sup>8</sup>

Not applicable

4.1.7 Accidental actions

Not applicable

4.1.8 Actions during construction

Construction delivery vehicles and crane loads will be considered as part of the retaining structure design which will be carried out by a specialist consultant once appointed. They will provide an addendum to this AIP for their elements of the design.

4.1.9 Any special action not covered above 9

Not Applicable

4.2 Heavy or high load route requirements and arrangements being made to preserve the route, including any provision for future heavier loads or future widening

Not Applicable

4.3 Minimum headroom provided

Not Applicable

4.4 Authorities consulted and any special conditions required

The following organisations have been consulted as part of the design process:

Crossrail

Utility companies

Camden Council

4.5 Standards and documents listed in the Technical Approval Schedule

<del>BS 5268; Part 2; 2002</del>	<del>Structural Use of Timber</del>
BS 5400	Steel concrete and composite bridges
Part 1, 1988	General Statement (see BD1)
Part 2; 1978	Specification for loads (see BD1)
<del>Part 3; 2000</del>	<del>CP for design of steel bridges (see BD1)</del>
<del>Part 4; 1990</del>	<del>CP for design of concrete bridges (see BD2)</del>
<del>Part 5; 1979</del>	<del>CP for design of composite bridges (see BD16)</del>
<del>Part 9; 1983</del>	<del>Bridge bearings (see BD20)</del>
<del>Part 10; 1980</del>	<del>CP for fatigue (see BD9)</del>
BS 5628; Part 1; 1992	Unreinforced Masonry
BS 5930; 1999	Site Investigations
BS 6031; 1981	Earthworks
BS 8002; 1994	Earth retaining structures
BS 8004; 1986	Foundations
<del>BS 8118; 1991</del>	<del>The structural use of aluminium</del>

4.6 Proposed Departures relating to departures from standards given in 4.5

None

4.7 Proposed Departures relating to methods for dealing with aspects not covered by standards in

4.5

None

## 5. STRUCTURAL ANALYSIS

5.1 Methods of analysis proposed for superstructure, substructure and foundations

The slab, secondary beams, primary beams and columns will be analysed in a 3D structural analysis software and element design will be carried out by hand calculation. The pile design for the retaining wall and load bearing piles will be carried out by a specialist consultant to be appointed once planning permission has been granted. They will provide an addendum to this document outlining the proposed design methodology.

## 5.2 Description and diagram of idealised structure to be used for analysis

The pile designer will provide details of their design in an addendum to this document once appointed. The slab supporting the road will span approximately 1.44m continuously between secondary beams. The secondary beam will have a fixed connection to the top of the contiguous piled wall where it will coincide with the capping beam. The secondary beam will be designed as being simply supported by the primary beam which is also simply supported between in-situ columns down to the floor of the basement. The slab will be designed for HA loading and HB loading as set out in BS5400.

The columns will be supported on a cantilevered ground beam which will transfer downward load to the centre of a pile cap supported by 3 piles. The tail of the ground beam will contain one pile acting as a tension pile at the outer edge of the basement.

The basement floor slab will tie into and span between the ground beams and will be designed to resist 2.5m of hydrostatic pressure.

## 5.3 Assumptions intended for calculation of structural element stiffness

Element Stiffness for concrete members will be derived in accordance with BS5400 Part 4 Clause 4.4, using full elastic uncracked member cross-sections ignoring the presence of reinforcement.

## 5.4 Proposed range of soil parameters to be used in the design/assessment of earth retaining elements <sup>13</sup>

To be provided by pile design consultant as an addendum once they have been appointed.

# 6. GEO TECHNICAL CONDITIONS

## 6.1 Acceptance of recommendations of the Geotechnical Design Report to be used in the design/assessment<sub>1</sub> and reasons for any proposed changes

To be provided by pile design consultant as an addendum once they have been appointed.

## 6.2 Summary of design for highway structure in Geotechnical Design Report

To be provided by pile design consultant as an addendum once they have been appointed.

## 6.3 Differential settlement to be allowed for in the design/assessment<sub>1</sub> of the structure

To be provided by pile design consultant as an addendum once they have been appointed.

## 6.4<sub>b</sub> If the Geotechnical Design Report is not yet available, state when the results are expected and list the sources of information used to justify the preliminary choice of foundations

Survey and results expected early 2019 once existing highway has be closed. Previous boreholes carried out through stage house of theatre used for preliminary choice of foundations. Refer to Factual Site Investigation Report dated 25th Jan 2013

## **7. CHECK**

### **7.1 Proposed Category**

Category 1 check in accordance with BD2/12

### **7.2 If Category 3, name of proposed independent Checker**

Not applicable

7.3<sub>b</sub> Erection proposals or temporary works for which Types S and P Proposals will be required, listing structural parts of the permanent structure affected with reasons

Not applicable

## **8. DRAWINGS AND DOCUMENTS**

### **8.1 List of drawings (including numbers) and documents accompanying the submission <sup>15</sup>**

#### **Appendix A: Drawings**

2714-201 Proposed Piling Plan

2714-202 Proposed Ground Beam Plan

2714-203 Proposed RC Column and Ground Beam Plan

2714-204 Proposed Section A-A

2714-205 Proposed Section B-B

2714-206 Proposed Section C-C

2714-207 Proposed Section D-D

2714-CT001 Piling Plan Crossrail OS Grid

2714-CT002 Piling Plan Crossrail OS Grid (Section)

#### **Appendix B: Idealised Structure**

Sketch 2714-IST-01

#### **Appendix C:**

Factual Site Investigation Report 25th Jan 2013

Site Investigation Report 29 January 2018

### **8.2<sub>A</sub> List of construction and record drawings (including numbers) to be used in the assessment**

Not applicable

### **8.3<sub>A</sub> List of pile driving or other construction records <sup>19</sup>**

Not applicable

8.4A List of previous inspection and assessment reports

Not applicable

**9. THE ABOVE IS SUBMITTED FOR ACCEPTANCE**

We confirm that details of the temporary works design will be/have been<sup>1</sup> passed to the permanent works Designer for review.<sup>16</sup>

Signed

Name \_\_\_\_\_

Design/Assessment<sup>1</sup> Team Leader

Engineering Qualifications \_\_\_\_\_<sup>17</sup>

Name of Organisation \_\_\_\_\_

Date \_\_\_\_\_

**10. THE ABOVE IS REJECTED/AGREE D<sup>1</sup> SUBJECT TO THE AME NDME NTS AND  
CONDITIONS SHOWN BELO W<sup>18</sup>**

Signed \_\_\_\_\_

Name \_\_\_\_\_

Position held \_\_\_\_\_

Engineering Qualifications \_\_\_\_\_<sup>17</sup>

TAA \_\_\_\_\_

Date \_\_\_\_\_



## Notes

*D. Indicates clauses to be used in Design AIP only.*

*A. Indicates clauses to be used in Assessment AIP only.*

*1. Delete as appropriate.*

*2. For a bridge, give over and/or under.*

*3. Include weight, height, width and any environmental restrictions at or adjacent to the bridge.*

*4. In cases of design, give applicable exposure classes for particular concrete structural elements. In cases of assessment, give material*

*strengths from record drawings or intrusive investigation. For all material strengths given, list the relevant codes/standards.*

*5. Designers should name the CDM co-ordinator and confirm that the CDM co-ordinator has reviewed the risks and hazards identified*

*in the AIP and is satisfied. Also see clause 2.12(i), (ii) and (iii).*

*6. e.g. HA Loading.*

*7. e.g. HB or SV Loading.*

*8. e.g. Individual vehicle which includes the following information as applicable:*

*a) Gross weight of the vehicle in tonnes and vehicle type and number.*

*b) Axle load and spacing (longitudinally and transversely).*

*c) Air cushion in tonnes over area applied (in metres, longitudinally and transversely).*

*d) Single or twin tyres and wheel contact areas.*

*9. e.g. seismic loading, atmospheric icing, floating debris etc.*

*10. If in doubt, the heavy or high load route requirements should be confirmed by the relevant administration e.g. Abnormal Indivisible*

*Load team in HA. Initial indication can be found from the route maps which are available from Circular Roads No 61/72 – Routes for*

*heavy and high abnormal loads, and also from the website*

*<http://www.esdal.com> or in Scotland <http://www.transportscotland.gov.uk/reports/road/j12054-00.htm>*

*11. List the main structural elements for superstructure, substructure and foundation. If the designs of the superstructure, substructure*

*and/or foundation are carried out by different teams, refer to cl. 2.22 and 2.42.*

*12. Factors of Safety are required where limit state design codes for bridges are not used. See 4.17(e).*

*13. Where no such geotechnical information is available, suggested earth pressure coefficient values given in relevant DMRB parts should be used instead.*

*14. When the results of the ground investigation become available, an addendum to the AIP, covering section 6, must be submitted to*

*the TAA. The addendum must have its own sections 8, 9 and 10 to provide a list of drawings, documents and signatures*

*15. Include, without limitation:*

*a) Technical Approval Schedule (TAS).*

*b) General Arrangement Drawing.*

*c) Relevant extracts from the Geotechnical Design Report, Inspection Report, Intrusive Investigation Report, Previous Assessment Report (or reference for Report).*

*d) Departures.*

*e) Relevant correspondence and documents from consultations.*

*16. This statement is applicable to temporary works design AIP only.*

*17. CEng, MICE, MStructE or equivalent.*

*18. AIP is valid for three years after the date of agreement by the TAA. If the construction has not yet commenced within this period,*

*the AIP must be re-submitted to the TAA for review.*

*19. Include details of previous structural maintenance and/or strengthening works.*