Essex Highways

Sturmer Station Bridge
Bridge Replacement Scheme
ECC Bridge No 1426

Approval in Principle
March 2023

RINGWAY JACOBS
integrated expertise

Essex County Council

Document Control Sheet

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Name of Project	Sturmer Station Bridge Replacement Scheme
Name of Bridge	Sturmer Station Bridge
Structure No	Bridge No. 1426
Summary	Sturmer Station Bridge is located in Sturmer village, south of Haverhill, and carries the B1061 Water Lane over Stour Brook. This Approval in Principle is for a new single span concrete bridge which is to replace the present two arch brick structure. Essex County Council has programmed the replacement of the current bridge as it has been identified as restricting Stour Brook flow which is a contributing factor to the flooding of residential properties and the highway in the A1017 Rowley Hill area. Additionally, the present bridge's main span arch barrel is in poor condition with a number of significant longitudinal cracks which adversely affect the load capacity of structure. Departures from standard are presented for acceptance for the proposed form of the bridge parapets, the omission of approach safety fences and the highway cross-section, where absence of footways and width are substandard. Construction is programmed to start in financial year 2023-2024.

1 Highway Details

Photo-1: View along B1061 over present bridge, looking southwest

1.1 Type of highway

The highway is a B-class road which Essex County Council categorise PR2 (Priority Route 2) network as per the ECC Highways Maintenance Strategy and Policy.

The highway is a single carriageway; generally without footways.

1.2 Design traffic speed

The design traffic speed over the bridge is 30 mph (the present signed speed limit).

1.3 Existing restrictions

There are no weight, height, width or any environmental restrictions at or adjacent to the bridge.

2 Site Details

2.1 Obstacles crossed

Sturmer Station Bridge crosses Stour Brook (a tributary of the River Stour).

Photo-2: View of existing watercourse upstream of existing bridge looking southeast; Stour Brook flows south-easterly through the structure.

3 Proposed Structure

Scheme Background

Sturmer Station Bridge is owned and maintained by Essex County Council (ECC).

The Bridge is located in Sturmer village, south of Haverhill, and carries the B1061 (Sturmer to Burrough Green (Newmarket)) road over Stour Brook (an Environment Agency designated Main River).

The present bridge is a two arch brick structure, which has been extended and undergone repair over a period of many years, it comprises:

- A south span arch with a square span of 3.27 m which is skewed at approximately 12º to the carriageway. This span has been widened on the east (downstream) side. In addition to the longitudinal construction joint there are a number of historical longitudinal cracks in this arch barrel. The original section of this arch may date from the early 1800's or possibly earlier
- A north span arch with a square span of 1.53 m which is skewed at approximately 16º to the carriageway. It is believed this span was constructed in 1969 as a flood relief measure by Essex Rivers Authority. The form of the north span as originally constructed is unknown but it

now has a concrete invert which is at a much higher level invert than that of the south span arch

Essex County Council documents indicate the structure has been affected by scour and a section of the bridge underpinned; there is site evidence to indicate the foundations are protected by concrete scour protection measures. Steel trench sheets are installed upstream of the bridge to retain the northwest river bank above the level of the river channel.

There is a history of fluvial and pluvial flooding in the Sturmer A1017 Rowley Hill/Water Lane/Hill Lane area which has affected residential properties, vehicles, gardens and the highway.

The Environment Agency has undertaken a flood modelling and mapping study of the River Stour catchment (which includes Stour Brook) which concluded residential properties at Rowley Lane may be at risk of fluvial flooding in events greater than the 50% Annual Exceedance Probability (AEP) due to Sturmer Station Bridge acting as a constriction on flows.

Essex County Council therefore commissioned Essex Highways to undertake an Option Study to investigate improving the conveyance of Stour Brook flow at Sturmer Station Bridge. The Option Study recommended replacing the present brick arch bridge with an integral reinforced concrete structure with a greater waterway cross-section to reduce the flood levels and flood risk upstream of the structure.

Also, a recent reassessment of the brick arch structure, based on its current (2019) condition, found it to be sub-standard in terms of its load capacity being unable to carry the full range of currently permitted vehicles with the required factor of safety.

Essex County Council has therefore commissioned Essex Highways to undertake a feasibility study for demolishing the present structure and constructing a new structure as detailed in this Approval in Principle.

3.1 Description of structure and design working life

The replacement bridge is to be a single span semi integral concrete structure with a larger waterway cross-section than is provided by the present brick arch structure.

As the bridge is in a rural setting and adjoins a Grade II Listed Building the new bridge will have brick faced concrete parapets and substructure elements.

Due to highway boundary constraints the new bridge will occupy a similar footprint and have a similar highway arrangement to those of the present structure.

The carriageway cross-section will consist of a single carriageway (with a minimum width of 5.0 m) with kerbed hard verges 0.4 m wide over the structure.

The design working life category of the structure is 5 with an indicative working life of 120 years in accordance with NA to BS EN 1990:2002 + A1:2005 [NA.2.1.1].

For proposed and existing bridge general arrangement drawings refer to Appendix A.

3.2 Structural type

The proposed structure is a single span integral concrete bridge.

Integral reinforced concrete retaining walls are to support the highway above the level of the adjoining riverbanks.

3.3 Foundation type

The new bridge foundations will comprise spread foundations with mini piles underneath (a piled raft) to increase the stiffness of the Lowestoft Formation or bored cast in place piles – this shall be determined through geotechnical design not yet done.

3.4 Span arrangements

The proposed replacement bridge is a single span structure with a square clear span distance of 6.0 m between abutment faces.

3.5 Articulation arrangements

Bridge shall be of semi-integral construction with the deck simply supported on elastomeric bearings installed on the cantilevered abutment walls. The deck will be longitudinally restrained at one abutment; transverse restraint will be provided at both abutments.

3.6 Classes and levels

3.6.1 Consequence class

The Consequence Class for failure or malfunction of the structure is Medium (CC2) in accordance with BS EN 1990:2002+A1:2005 [B3.1] and NA to BS EN 1990:2002+A1:2005 [NA.3.2.1].

3.6.2 Reliability class

The Reliability Class for the structure is taken as RC2 therefore the multiplication factor K_{FI} applied to partial factors is 1.0 in accordance with BS EN 1990:2002+A1:2005 [B3.3].

3.6.3 Inspection level

The Inspection Level during construction of the structure, relating to RC2, is IL2 (normal inspection) in accordance with BS EN 1990:2002+A1:2005 [B5].

3.7 Road restraint systems requirements

To maintain the character of the semi-rural setting the bridge and retaining wall parapets will be reinforced concrete faced with brick and comply with the height requirement for vehicle parapets given in CD 377.

The use of brick cladding has been agreed with the TAA during the preparation of this AIP.

Due to site constraints (adjoining residential property accesses and Parish Council owned car parking area) safety barriers will not be provided at the bridge approaches.

3.8 Proposals for water management

In the permanent situation Stour Brook will flow through the proposed structure which will have a greater waterway area than that provided by the present bridge. River modelling shows the proposed structure will reduce flood levels and the risk of flooding upstream of the bridge and that the increase in levels downstream of the bridge will be within acceptable limits (i.e. flow will remain within the existing riverbanks).

The highway will drain longitudinally over the structure to gullies which outfall into Stour Brook.

The bridge foundations will be resilient to scour.

To prevent water ingress within the structure the deck top surface, and the top of the adjoining vertical external surfaces to a level of 200mm below the soffit of the deck slab, shall be protected with a suitable bridge deck waterproofing system in accordance with CD 358 MCHW1 Series 2000. All other concrete surfaces in contact with soil or backfill shall be waterproofed in accordance with the requirements for Below Ground Concrete Surfaces as given in MCHW1 Clauses 2004 and 2006.

Bridge construction will be jointless.

During the construction phase watercourse management will comprise local temporary diversion of Stour Brook and/or temporary impoundment of Stour Brook and over-pumping or fluming through the bridge works area (detailed proposals for water management to be developed as the scheme progresses).

3.9 Proposed arrangements for future maintenance and inspection

3.9.1 Traffic management

Bridge and road closure will be required for undertaking carriageway repair/resurfacing works at and in the vicinity of the bridge.

The diversion route for traffic avoiding Sturmer Station Bridge is via Sturmer, Haverhill, Little Wratting, Kedington and Calford Green (and vice versa), a diversion length of 6.5 miles (10.4 km).

Traffic face maintenance and repair of the parapets may be undertaken using lane closures which require vehicles to negotiate the bridge using single-way shuttle working controlled by Stop/Go boards or temporary portable signals with priority given to traffic heading north from the B1061/A1071 junction. Should it be necessary to restrict the shuttle working to cars and light traffic only HGV's would use the diversion route identified above.

3.9.2 Arrangements for future maintenance and inspection of structure. Access arrangements to structure

Generally, routine bridge maintenance requirements are expected to be minimised due to the integral form of the proposed structure.

A road closure will be required for undertaking waterproofing replacement and carriageway repair/resurfacing works at the bridge.

Traffic face maintenance and minor repairs to the parapets may be undertaken from the carriageway using lane closure traffic management.

Maintenance to the riverside faces of the suspended span will be undertaken from temporary scaffold access platforms installed over the watercourse. Maintenance to the riverside faces of the retaining walls and retaining wall parapets may be undertaken from the riverbanks.

Traffic face inspection of the parapets may be undertaken from the carriageway using lane closure traffic management.

Inspection of the bridge soffit and abutments will require descending the river north bank on foot and entry to the watercourse using thigh waders. The bridge elevations may be viewed from the river north banks and the watercourse.

The provision of safe access (steps and/or handrails) for periodic inspection will be investigated as the scheme progresses.

3.10 Environment and sustainability

The scale of the proposed replacement structure and the associated carriageway works are considered to be commensurate with the scheme's primary objective of reducing flood levels and the risk of flooding upstream of the bridge (allowances have been made for the effects of climate change).

The proposed bridge aesthetics are in keeping with the semi-rural setting of the site.

The use of materials will be commensurate with the requirements for durability, resilience and strength.

The scheme is considered to represent good 'whole-life' value across the design life of the structure.

The scheme is shaped by the opinions of the Parish Council, Sturmer Flood Action Group and Environment Agency.

Subject to meeting specification requirements and being economically viable materials arising from demolition of the present structure will be re-used on site or re-cycled. Where possible backfill materials will be sourced from excavated materials.

Should the replacement structure need to be demolished the reinforced concrete is a viable source of aggregate which may be satisfactorily used in granular subbases, soil-cement, and in new concrete. The reinforcement can be recovered for recycling and reuse.

3.11 Durability - materials and finishes

Durability of the structure will be achieved through the form of the bridge construction (i.e. integral deck/abutments), the design and detailing of structural elements and by specification of materials (and workmanship) in accordance with the Design Manual for Bridges and Bridges/Manual of Contract Documents for Highway Works (MCHW).

Materials and finishes:

Bridge structure	
Exposure classes	In accordance with BS EN 206:2013+A1:2016 and BS 8500-1:2015+A2:2019 **Deck and Parapet Concrete Cores:** Carbonation class XC3/4 Chloride class XD3 Freeze-thaw class XF2 **Abutments:** Carbonation class XC3/4 Chloride class XD3 Freeze-thaw class XF2 **Foundations:** Chloride class XD2 Design sulfate class DS-1
Concrete strength classes	In accordance with BS 8500-1:2015+A2:2019, strength classes: **Deck** – C40/50 **Abutments** – C40/50 **Foundations** – C35/45
Reinforcement	Grade B500B or B500C ribbed bars – yield strength 500 N/mm^2.

Nominal cover to reinforcement	Nominal cover to reinforcement in accordance with BS EN 206-1 and BS8500-1. 45 + Δc (10 mm) = 55 mm
Concrete finishes	Exposed concrete surfaces - formed F3, unformed U3, U4 finish to top of deck. Unexposed concrete surfaces – formed F1, unformed U1.
Waterproofing for concrete	Deck to be waterproofed using a permitted waterproofing system in accordance with Series 2000 of the Specification for Highway Works (SHW) and to the requirements of CD 358. Where required for the waterproofing system a 20mm thick Additional Protective Layer (APL) of sand asphalt will be installed in accordance with cl. 2003 of the specification. Where no APL is required, the waterproofing system will be overlaid with a 45mm layer of hot rolled asphalt (HRA) binder course to Clause 943 of the specification (50mm thick no fines concrete will be provided below verges). Waterproofing for below ground concrete surfaces in accordance with SHW Series 2000.
Brickwork	Bridge parapets to be faced in red clay bricks type F2, S2 (frost resistant, low soluble salts) to BS EN 771-1 laid in lime mortar with bucket handle or weather-struck joints.
Movement joints	10 mm wide joints with compressible joint filler material (cellular polyethylene or cellular polyurethane) and sealant (polysulfide or low modulus silicone).

Retaining walls	
Exposure classes	In accordance with BS EN 206:2013+A1:2016 and BS 8500-1:2015+A2:2019 **Stems and Parapet Cores** Carbonation class XC3/4 Chloride class XD3 Freeze-thaw class XF2 **Foundations** Chloride class XD2 Design sulfate class DS-1
Concrete strength classes	In accordance with BS 8500-1:2015+A2:2019, strength classes: **Stems** – C40/50 **Foundations** – C35/45
Reinforcement	Grade B500B or B500C ribbed bars – yield strength 500 N/mm^2.
Nominal cover to reinforcement	Nominal cover to reinforcement in accordance with BS EN 206-1 and BS8500-1. 45 + Δc (10 mm) = 55 mm
Concrete finishes	Unexposed concrete surfaces – Formed F1, unformed U1.
Waterproofing for concrete	Waterproofing for below ground concrete surfaces in accordance with SHW Series 2000.
Brickwork	Retaining wall parapets and brook side elevations to be faced in red clay bricks type F2, S2 (frost resistant, low soluble salts) to BS

	EN 771-1 laid in lime mortar with bucket handle or weather-struck joints.
Movement joints	10 mm wide joints at 6.0 m maximum centres with compressible joint filler material (cellular polyethylene or cellular polyurethane) and sealant (polysulfide or low modulus silicone).

3.12 Risks and hazards considered for design, execution, maintenance and demolition. Consultation with and/or agreement from Overseeing Organisation

In addition to the risks and hazards usually associated with highway bridge construction, maintenance and demolition the following risks and hazards particular to this scheme are:

- Site history of high river levels and flooding
- HGV road access to site restricted, vehicle turning limited
- Very compact site with limited working space
- Options for location (and size) of contractor site compound/storage, limited
- Works area enclosed by residential properties and local heritage trail
- Need to maintain access to residential properties which are in very close proximity to bridge works area
- Working adjacent to buildings which are believed to be founded at much higher levels than the bridge and excavation depths; adjoining buildings may need underpinning, temporary support
- River bank in private ownership southwest of bridge is in poor condition
- Works situated in politically sensitive location

The projects risks have been reviewed, the hazards identified and their reduction / elimination management has been compiled in the “Hazard Elimination and Risk Reduction Register”

3.13 Estimated cost of proposed structure together with other structural forms considered (including where appropriate proprietary manufactured structure), and the reason for their rejection (including comparative whole life costs with dates of estimates)

The estimated cost of the proposed bridge replacement scheme permanent works is £800,000 to £900,000.

Due to the environmentally sensitive nature of the site, which places significant constraints on the appearance of the replacement structure and the highway layout, no other structural forms have been considered.

3.14 Proposed arrangements for construction

3.14.1 Construction of structure

Construction of the proposed structure will require:

- B1061 road closure and traffic diversion
- Demolition of adjacent private garage structures to make way for NMU and service bridge(s)

- Diversion of pedestrians and cyclists requiring provision of temporary bridge over Stour Brook
- Diversion of utility apparatus requiring provision of temporary bridge over Stour Brook
- Taking measures to temporarily stabilise/support adjoining buildings
- Careful demolition of the present brick arch structures
- Temporary impoundment of Stour Brook and over pumping of flow or partial impoundment and local diversion of the watercourse
- Install piling working platform and forming pile foundations
- Construction of the new bridge and retaining walls
- Permanent diversion of utility apparatus onto the new bridge
- Re-profiling watercourse channel and reinstatement of river north banks
- Reinstatement of carriageway

3.14.2 Traffic management

The section of the B1061 affected by the bridge replacement activities will be closed to motorised vehicles for the duration of the works.

Traffic will be diverted via Sturmer, Haverhill, Little Wratting, Kedington and Calford Green (and vice versa), a diversion length of 6.5 miles (10.4 km).

Pedestrians, cyclists and horse riders will be required to the cross Stour Brook by means of a temporary scaffold bridge installed upstream of Sturmer Station Bridge; or alternatively non-motorised road users may be diverted along the Sturmer Heritage Trail to avoid the bridge works (all subject to Parish Council and stakeholder negotiations).

3.14.3 Service diversions

Utility service diversions are required for construction of the proposed structure permanent works.

The following services are in the vicinity of the bridge works area:

Utility company	Apparatus	Location	Proposed Temporary Diversion	Proposed Permanent Diversion
Anglian Water	Gravity foul sewer 150 mm diameter VC.	In Water Lane carriageway south of the bridge, crosses beneath Stour Brook west of the bridge and continues to Pumping Station.	Temporary diversion unlikely to be necessary.	Permanent diversion unlikely to be necessary.
	Rising main 150 mm diameter DI.	From Pumping Station northwest of bridge, crosses Stour Brook west of bridge	Temporary diversion unlikely to be necessary.	Permanent diversion unlikely to be necessary.

Utility company	Apparatus	Location	Proposed Temporary Diversion	Proposed Permanent Diversion
		and continues in south easterly direction in 2 Station Cottage grounds.		
	Potable water GI 3 inch diameter main	In Water Lane footway south of bridge, crosses Stour Brook in a suspended duct immediately west of the bridge and continues north from bridge in verge.	Divert onto utility temporary bridge installed over Stour Brook west of Sturmer Station Bridge.	Permanent diversion into duct cast in new bridge concrete deck.
BT Openreach	Underground plant	In Water Lane footway south of bridge, then carried by bridge and continues to pole located in verge northwest of bridge.	Divert onto utility temporary bridge installed over Stour Brook west of Sturmer Station Bridge.	Permanent diversion into duct cast in new bridge concrete deck.
	Overhead plant	Pole in verge north west of bridge supporting OH crossing Water Lane. (Pole shared with UKPN.)	Temporary diversion unlikely to be necessary.	Permanent diversion not required.
Cadent Gas	Low pressure 125 mm PE	In Water Lane carriageway and carried by bridge.	Divert onto utility temporary bridge installed over Stour Brook west of Sturmer Station Bridge.	Permanent diversion into duct cast in new bridge concrete deck.
	Medium pressure 90 mm PE main	In footpath (dismantled railway line) north west of bridge.	Plant remote from Bridge - temporary diversion should not be necessary.	Permanent diversion not required.
Gigaclear	Fibre broadband	In Water Lane carriageway and carried by bridge. Cables are installed unducted and at	Option 1 – support plant in place during works.	Option 1 – install plant in split duct/ducts cast in new bridge concrete deck.

Utility company	Apparatus	Location	Proposed Temporary Diversion	Proposed Permanent Diversion
		shallow depth in trench originally used for UKPN.	Option 2 - divert onto utility temporary bridge installed over Stour Brook west of Sturmer Station Bridge.	Option 2 - permanent diversion into duct/ducts cast in new bridge concrete deck.
Street lighting (owner? – possibly Sturmer Parish Council)	Lighting column in verge.	In verge north west of Sturmer Station Bridge.	Temporary disconnection may be necessary.	
UKPN	Underground LV plant.	Plant in 95 mm EW duct in Water Lane carriageway and carried by bridge.	Option 1 – support plant in place during works.	Option 1 – install plant in split duct/ducts cast in new bridge concrete deck.
			Option 2 - divert plant onto utility temporary bridge installed over Stour Brook west of Sturmer Station Bridge.	Option 2 - permanent diversion into duct/ducts cast in new bridge concrete deck.
	Overhead plant	Pole in verge north west of bridge supporting OH crossing Water Lane. (Pole shared with BT Openreach.)	Temporary diversion unlikely to be necessary.	Permanent diversion not required.

3.14.4 Interface with existing structures

The present bridge and retaining walls are all to be demolished and replaced.

The traffic faces of the new bridge parapets are to be in the same position (and orientation) as those of the present structure. However, as the proposed structure is marginally wider than the present bridge it will be necessary to permanently acquire land to accommodate the new works.

As the expected proposed bridge founding levels are lower than those of the adjoining building and walls of the existing building the Contractor shall design a temporary and/or permanent works solution to the problem of supporting these structures.

3.15 Resilience and security

The structure, which carries a PR2 route, is important locally due to it providing a link between the PR1 (A143 and A1017 roads) network and a crossing point over Stour Brook. However, the bridge itself is not a strategic asset and no measures beyond normal design criteria are necessary for the structure.

The form and the materials proposed for the new structure are resistant to damage which may arise from the actions of vandals and thieves.

4 Design Criteria

4.1 Actions

4.1.1 Permanent actions

Self-weight, super-imposed, carriageway construction and weight of soil in accordance with BS EN 1991-1-1:

Normal weight reinforced concrete density $\gamma = 25$ kN/m^3

Asphaltic concrete density $\gamma = 24$ to 25 kN/m^3

Stone Mastic asphalt density $\gamma = 18$ to 22 kN/m^3

Hot rolled asphalt density $\gamma = 23$ kN/m^3

Bridge infill density $\gamma = 18.5$ to 19.5 kN/m^3

Brickwork density $\gamma = 18.5$ to 19.5 kN/m^3

Abutment and retaining wall backfill density $\gamma = 20.0$ kN/m^3

The UK National Annex to BS EN 1991-1-1:2002 [Table NA.1] requires the deviation of the total thickness of waterproofing, surfacing and other coatings to be between +55% and – 40%.

Bridge structure differential settlement as section 6.3.

4.1.2 Snow, wind and thermal actions

Snow loading - due to the form and location of the bridge snow loading is considered unlikely to be a critical design case for the structure; therefore snow loading will be ignored (National Annex (NA) to BS EN 1991-1-3 NA.4.1.1).

Wind loading – due to the form and proportions of the bridge wind loading is considered unlikely to be critical design case for the structure therefore wind loading will be ignored.

Thermal actions considered in accordance with Section 6 of BS EN 1991-1-5 and NA to BS EN 1991-1-5, adopting Approach 2 for determination of vertical temperature difference component.

4.1.3 Actions relating to normal traffic under AW regulations and C&U regulations

<u>BRIDGE STRUCTURE:</u>

a) Deck

Load Model 1 (LM1) comprising double-axle concentrated and uniformly distributed loads, which cover most of the effects of the traffic of lorries and cars in accordance with BS EN 1991-2:2003 [4.3.2] and NA to BS EN 1991-2:2003 [NA.2.12 and 13].

Load Model 2 (LM2) a single axle load applied on specific tyre contact areas which covers the dynamic effects of the normal traffic on short structural members in accordance with BS EN 1991-2:2003 [4.3.3] and NA to BS EN 1991-2:2003 [NA.2.14 and 15].

b) Abutments

Horizontal surcharge model for vertically spanning abutments in accordance with PD 6694-1:2011+A1:2020 [7.6.2].

RETAINING WALLS

The model vehicle with the configuration given in NA to BS EN 1991-2 (2003) - Rev 2008 Figure NA.6 will be used and the retaining wall loaded with vehicle loads as described in NA to BS EN 1991-2 (2003) - Rev 2008 NA.2.34.2.

Horizontal surcharge model for vertically spanning retaining walls in accordance with PD 6694-1:2011+A1:2020 [7.6.3.2].

4.1.4 Actions relating to General Order traffic under STGO regulations

BRIDGE STRUCTURE

Load Model 3 (LM3) a set of assemblies of axle loads representing special vehicle (e.g. for industrial transport) SV80 in accordance with BS EN 1991-2:2003 [4.3.4] and NA to BS EN 1991-2:2003 [NA.2.16.1, 2.16.3 and 2.16.4].

RETAINING WALLS

Load Model 3 (LM3) a set of assemblies of axle loads representing special vehicle (e.g. for industrial transport) SV80 in accordance with BS EN 1991-2:2003 [4.3.4] and NA to BS EN 1991-2:2003 [NA.2.16.1, 2.16.3, 2.16.4 and 2.34.3] and their horizontal surcharge.

4.1.5 Footway or footbridge variable actions

BRIDGE STRUCTURE

Load Model 4 (LM4) crowd loading, uniformly distributed loading on the verges in accordance with BS EN 1991-2:2003 [5.3.2.1] and NA to BS EN 1991-2:2003 [NA.2.36].

Concentrated load in accordance with BS EN 1991-2:2003 [5.3.2.2].

RETAINING WALLS

Load Model 4 (LM4) crowd loading, uniformly distributed loading on the verge in accordance with BS EN 1991-2:2003 [5.3.2.1] and NA to BS EN 1991-2:2003 [NA.2.36] horizontal surcharge.

4.1.6 Actions relating to Special Order Traffic, provision for exceptional abnormal indivisible loads including location of vehicle track on deck cross-section

Not applicable.

4.1.7 Accidental actions

BRIDGE STRUCTURE

Vehicle accidental actions in accordance with BS EN 1991-2:2003 [4.7.3].

Vehicle collision force on the parapets for Class B normal containment rigid parapets (e.g. reinforced concrete parapets) in accordance with BS EN 1991-2:2003 [4.7.3.3] and NA to BS EN 1991- 2:2003 [NA.2.30].

Vehicle collision forces on kerbs in accordance with BS EN 1991-2:2003 [4.7.3.2].

RETAINING WALLS

Vehicle accidental actions in accordance with BS EN 1991-2:2003 [4.7.3].

Vehicle collision force on the parapets for Class B normal containment rigid parapets (e.g. reinforced concrete parapets) in accordance with BS EN 1991-2:2003 [4.7.3.3] and NA to BS EN 1991- 2:2003 [NA.2.30].

4.1.8 Actions during construction

None considered.

4.1.9 Any special action not covered above

None.

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 - the B1061 is neither a heavy nor high load route.

4.3 Proposed minimum headroom to be provided

Headroom is unrestricted for vehicles using the bridge.

The waterway area of the proposed structure is greater than that provided by the present brick arch structure. The vertical clearance between river bed and deck soffit is approximately 1.75 m.

4.4 Set out measures that will be incorporated into the design to minimise maintenance

Due to the integral nature of the proposed structure the design should have a minimal routine maintenance requirement thereby reducing the safety risk to the workforce and reducing disruption to the network.

The design does not include elements with relatively high maintenance intervention requirements.

4.5 Authorities consulted and any special conditions required

Essex County Council Planning has been consulted and provided the following comments in respect of the proposed structure:

"The proposed works to the bridge would fall on land within the boundaries of a road/highway which has been considered as required for the maintenance and improvement of the bridge. The works are proposed to be undertaken by the statutory highways authority.

Taking this into consideration, this advice considers that the proposed reconstruction of the existing Sturmer Station Bridge would be permitted development under Class A (Development by Highways Authorities) Part 9 of the Town and Country Planning (General Permitted Development) (England) Order 2015 (as amended).

Caveats

We have not screened the works for EIA. If it was considered that this would be classed as EIA development (albeit unlikely), permitted development would not apply.

Please note: Station Corner Cottage is a Grade II Listed Building which is located on the corner of Water Lane and Rowley Hill to the south of the Bridge.

Due care and consideration must be given to this building, as well as any other nearby residential properties during any proposed works in relation to the bridge.˝

Environment Agency has liaised with Essex Highways on this scheme and is supportive of a bridge replacement which reduces the flood levels and flooding risk upstream of the structure. It is likely to be looked on favourably, in flood risk terms, if a Permit application is made for the proposed structure.

4.6 Standards and documents listed in the technical approval schedule (TAS)

Standards and documents are listed in the Technical Approval Schedule in Appendix s to be prepared by the Contractor/Designer and is to be included in their AIP.

4.7 Proposed departures from standards listed on 4.6

Proposed departures relating to departures from CG 300 TAS - Generic Technical Approval Schedule (TAS) are:

Departure from standard CD 127 - Cross-sections and headrooms: departure for non-standard highway cross-section proposed.

Departure from standard CD 377 - Requirement for road restraint systems: departures for the form and nature of the vehicle parapets proposed.

Departure from standard CD 377 - Requirement for road restraint systems: departure for the omission of safety barriers on the approaches to the structure.

4.8 Proposed departures from standards concerning methods for dealing with aspects not covered by standards in 4.6

In the absence of current guidance for the design of parapets of concrete and masonry construction it is anticipated that the Contractor shall use withdrawn British Standards BS 6779 Highway parapets for bridges and other structures (Part 2:1991 - Specification for vehicle containment parapets of concrete construction and Part 4:1999 - Specification for parapets of reinforced and unreinforced masonry construction).

Provisions of BS EN 1992-3:2006 [Annex M] are to be used for calculating the width of cracks induced by early thermal movement of concrete in accordance with the advice of the Highways Agency.

4.9 Proposed safety critical fixings

None considered within this AIP.

5 Structural Analysis

5.1 Method of analysis proposed for superstructure, substructure and foundations

The superstructure, substructure and foundations will be analysed by means of a 3D finite element model comprising 2D shell and 3D thick beam elements.

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

An idealised diagrams of the bridge structure and retaining walls is contained in Appendix (to be added).

5.3 Assumptions intended for calculation of structural element stiffness

Calculation of structural element stiffness will be based on uncracked cross sections and mean value of the modulus of elasticity in accordance with BS EN 1992-1-1:2004 [5.4]..

For thermal deformation, settlement and shrinkage effects at the ultimate limit state (ULS), a reduced stiffness corresponding to the cracked sections, neglecting tension stiffening but including the effects of creep, may be assumed. For the serviceability limit state (SLS) a gradual evolution of cracking should be considered.

5.4 Proposed range of soil parameters to be used in the design of earth retaining elements

Earth pressure coefficients are to be in accordance with PD 6694-1:2011+A1:2020.

Soil description	Range of soil parameters to be used
Fill - Granular Backfill type 6N	Angle of shearing resistance (ϕ') taken as 35º to which partial factors are applied. Design angles for shearing resistance (ϕ'_d) 29.3º to 35º. Backfill density 20 kN/m^3.

In accordance with PD6694-1:2009 cl 3.7 a model factor of 1.2 will be applied to K_A and K_0 for unfavourable pressures at the ultimate limit state.

6 Geotechnical Conditions

6.1 Acceptance of recommendations of ground investigation report to be used in the design and reasons for any proposed changes

An initial ground investigation at the bridge was undertaken in August 2021 which comprised two cable percussive boreholes installed to a depth of 10.45 m below carriageway levels. The boreholes were curtailed at these depths to avoid the potential risk of penetrating the chalk aquifer and encountering water under artesian pressure.

The aim of the initial investigations was to identify the feasibility of spread foundations founded at a relatively high level (i.e. just below the watercourse bed level). The ground investigation was able to confirm the ground condition which underlie the scheme surrounding Sturmer Station Bridge, as well as allowing for indicative geotechnical parameters to be estimated for use in design. However, a preliminary foundation options assessment determined that the Lowestoft Formation is not suitable for spread foundations due to the high settlement values determined.

The feasibility of spread foundations with mini piles underneath to increase the stiffness of the Lowestoft Formation is being investigated. If this option is not possible, further ground investigations would be required to allow for deep foundation designs.

6.2 Summary of design for highway structure in the Ground Investigation Report

Geotechnical Design Report Summary Information:

STRUCTURE NAME Sturmer Station Bridge – Bridge Replacement Scheme	**OS Grid Reference** TL 697 439 (569788 , 243976)	**Reference/ Comments**
STRUCTURE TYPE In-situ reinforced concrete portal frame bridge structure with pile foundations	**AIP Ref No.** N/A	
DESIGNER'S GEOTECHNICAL ADVISOR Jacobs	**DESIGN LIFE** 120 years	
GEOTECHNICAL CATEGORY 2	**QUANTITATIVE GEOTECHNICAL INVESTIGATIONS** Ian Farmer Associates (1998) Limited 17-18th August, 2021	See HD22/08 cl 3.2 & 3.3 and BS EN1997-1 cl 2.1(10) – (21)
SOILS / GEOLOGY The site consists of Made Ground overlying Glacial Till and Chalk	**RELEVANT TRIAL HOLES** Ian Farmer Associates (1998) Limited boreholes BH01 and BH02. British Geological Survey historical boreholes	
STRATA Within carriageway adjacent to present bridge: Asphalt Made Ground Alluvium (BH02 only) Lowestoft Formation	**TYPICAL DEPTHS** From 0.0 m to 0.16 - 0.25 m. From 016 – 0.25 m to 3.0 - 3.4 m From 3.0 - 4.5 m From 3.4 – 4.5 to > 10.45 m	
PREVIOUS GROUND HISTORY Original sections of the present bridge and carriageway are thought to be early 19th Century (or possibly C18th) the bridge and carriageway have been widened on the east side (possibly mid-C19th).		
CONTAMINATED GROUND RISK ASSESSMENT REQUIRED Environmental testing of soil samples undertaken as part of 2021 geotechnical investigations. Contaminated ground risk assessment is not required.		
GROUND WATER Ground water encountered by BH01 at 3.5m below ground level rising to 2.3 m. No groundwater encountered in BH02.		
PROTECTION OF STRUCTURE AGAINST CHEMICAL ATTACK ACEC classification AC-1.		
EARTH PRESSURE VALUES Imported granular backfill to structure: Angle of shearing resistance (ϕ') taken as 35º to which partial factors are applied: Equilibrium limit state (EQU) verification ϕ'_d = 32.5º, Ka 0.301, Ko = 0.463, Kp = 3.32 Structural (STR) and geotechnical (GEO) limit state verification Set M1 ϕ'_d = 35º, Ka = 0.271, Ko = 0.426, Kp = 3.69 Structural (STR) and geotechnical (GEO) limit states verification Set M2 ϕ'_d = 29.3º, Ka = 0.343, Ko = 0.511, Kp = 2.92		

SPREAD FOUNDATIONS

Structure Element	**Founding Stratum**	**Founding Level (m AOD)**	**Footing Size**	**Bearing Resistance (kN/m²)**	…ULS Comb 1 …ULS Comb 2 …SLS
Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	

PILE DESIGN						
Structure Element	**Founding Stratum**	**Toe Level (m AOD)**	**Pile dia (m)**	**Pile Length (m)**	**Pile Resistance (kN)**	
Bridge pile foundations	Lowestoft Formation TBC	TBC	TBC	TBC	TBCN	…ULS Comb 1 …ULS Comb 2 …SLS
DIFFERENTIAL SETTLEMENT Refer to AIP section 6.3.						
GEOTECHNICAL SUPERVISION / MONITORING Not applicable						

6.3 Differential settlement to be allowed for in the design of the structure

Simply supported deck, therefore differential settlement will not be considered.

6.4 If the Ground Investigation 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

An initial ground investigation has been undertaken using boreholes installed to a depth of 10.45 m below ground level.

Depending on the outcome of the foundations options assessment further ground investigations may be necessary to enable the design of deeper pile foundations.

7 Checking

7.1 Proposed category of Checking and Design Supervision level

Category 1 in accordance with CG 300.

The departure from standard outlined in 4.6, relates to the omission of approach safety barriers to the parapets, this is not considered to require application of Category 2.

DSL2 in accordance with BS EN 1990:2002+A1:2005 [B4].

7.2 If Category 3, name of proposed independent checkers

Not applicable

7.3 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 and documents accompanying the submission

Appendix A

Drawings: BR1426-00-0101 – Location Plan

BR1426-AIP-01 – Proposed Bridge General Arrangement for AIP

BR1426-01-1101 – Existing Bridge General Arrangement

Appendix B

Idealised Models for Analysis

Appendix C

Technical Approval Schedule

Appendix D

Departure from Standards:

Departure from Standard No. 1 – not used

Departure from Standard No. 2 - Departure from Standard for Omitting Vehicle Restraint Systems

Departure from Standard No. 3 - Departure from Standards for the Carriageway Cross-section

Essex County Council

Technical Approval Proposal

9 THE ABOVE IS SUBMITTED FOR ACCEPTANCE

Signed	_____	
Name		Design Team Leader
Engineering Qualifications		
Name of Organisation	Ringway Jacobs	
Date	_____	
Signed	_____	
Name		Check Team Leader
Engineering Qualifications		
Name of Organisation	Ringway Jacobs	
Date	_____	

10 THE ABOVE IS REJECTED/ ACCEPTED[1] AND RECOMMENDED FOR ACCEPTANCE

Signed _____

Name

Engineering Qualifications

Name of Organisation Ringway Jacobs

Date _____

11 THE ABOVE IS REJECTED/AGREED[1] SUBJECT TO THE AMENDMENTS AND CONDITIONS SHOWN BELOW

Signed _____

Name

TAA

Date _____

1. Delete as appropriate
2. CEng, MICE, MIStructE or equivalent
3. Agreement is valid for three years after the date of agreement by the TAA. If the recommendation has not been implemented within this period, the AIP Form must be re-submitted to the TAA for review