The Great Grid Upgrade

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Bramford to Twinstead Reinforcement

Volume 8: Examination Submissions

Document 8.8.11: Reports on Abnormal Indivisible Load Access for Cable Drums, Transformers and Shunt Reactors

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Executive summary

The Construction Traffic Management Plan (CTMP) for the Bramford to Twinstead Reinforcement (the project) **[document 7.6]** states that assessments have been undertaken of the routes anticipated to be used by abnormal indivisible loads (AIL).

The Local Highway Authorities requested sight of these assessments to provide confidence that the routes specified in Figure 2 of the CTMP are suitable for the AIL vehicles proposed. These documents were provided to the Local Highway Authorities on 8 December 2023 and are now being provided here for all parties to the Examination.

The Applicant engaged a specialist transportation and access consultant to undertake assessments of the AIL delivery routes required as part of the Bramford to Twinstead Reinforcement. These assessments are reported in the following appendices:

- The report for the delivery of 400kV Shunt Reactors to Bramford substation, presented in Appendix A;
- The report for the delivery of 400kV cable drums to the cable access points, presented in Appendix B;
- The report for the delivery of 400kV Super Grid Transformers (SGT) to the new Grid Supply Point (GSP) substation is presented in Appendix C; and
- A structural assessment of the A131 Town Bridge at Halstead is provided in support of the SGT AIL route in Appendix D.

These reports together assess AIL routes for all necessary AIL deliveries required by the project.

1. Introduction

1.1 Overview

1.1.1 The Applicant engaged a specialist transportation and access consultant to undertake assessments of the Abnormal Indivisible Load (AIL) delivery routes required as part of the Bramford to Twinstead Reinforcement as follows;

(i) Delivery of 400kV Shunt Reactors to Bramford substation, described further in Section 2.

(ii) Delivery of 400kV Cable Drums to cable drum access points, described further in Section 3.

(iii) Delivery of 400kV Super Grid Transformers (SGT) to the new Grid Supply Point (GSP) substation, described further in Section 4.

1.1.2 This document presents the three associated AIL reports in Appendices A, B and C and also includes in Appendix D a structural assessment of the A131 Town Bridge at Halstead in support of the AIL route described in Appendix C (for delivery of the SGTs to the GSP substation).

2. AIL Report for Shunt Reactors to Bramford

2.1 Review of AIL Report

2.1.1 The Applicant appointed a specialist consultant to undertake the AIL route assessment for the delivery of the shunt reactors to Bramford substation. The AIL report is attached as Appendix A.

2.1.2 The AIL report indicates that the National Highways preferred port of delivery is Ipswich. The report further indicates that the preferred delivery route by Suffolk County Council is via Cliff Quay/A14 Junction 55 and A1214, although the report states that a structural assessment will be required on a 'Raw Water Main Culvert' on the A1214.

2.1.3 The Applicant notes that the preferred AIL route is currently proposed for use by another National Grid Electricity Transmission project prior to any potential use by this project, and in this context any structural assessment of the 'Raw Water Main Culvert' on the A1214 may be undertaken by this earlier project.

2.1.4 The route from Ipswich is considered negotiable for the proposed shunt reactor transport arrangements subject to the removal of street furniture as detailed within the AIL report.

3. AIL Report for 400kV Cable Drum Deliveries

3.1 Review of AIL Report

3.1.1 The Applicant appointed a specialist consultant to undertake the AIL route assessment for the delivery of the 400kV cable drums to the cable drum access points within the cable sections of the transmission route. The AIL report is attached as Appendix B.

3.1.2 Four cable drum access points have been identified within the AIL report as follows:

1. Access Point AONB East – Quarry (D-AP2)
2. Access Point AONB West – A134 (F-AP5)
3. Access Point Stour Valley East Workhouse Green (G-AP4)
4. Access Point Stour Valley West (H-AP20)

3.1.3 No specific port of entry has been identified within the AIL report although it is noted that there are various ports in south-east England that are able to accommodate the 400kV cable drums. The report undertakes a review of access to the cable drum access points from the A12 and A14 trunk roads.

3.1.4 The report notes that for the access point at Stour Valley West (H-AP20) the AIL would be required to utilise the A131 Town Bridge at Halstead which was advised as unsuitable for all AILs above 44te gross. However, that structure has been subjected to a structural assessment as it also forms part of the AIL route for the SGT deliveries to the GSP substation (see Section 4 of this report and Appendix D for further details), which has confirmed the acceptability of this bridge for use for AIL deliveries.

3.1.5 AIL access is considered feasible to each of the cable drum access points, although the exact route would be determined at the time of movement by the appointed haulage contractor in consideration of the actual cable drum dimensions and associated road transport delivery vehicle.

4. AIL Report for Super Grid Transformers to Grid Supply Point Substation

4.1 Review of AIL Report

4.1.1 The Applicant appointed a specialist consultant to undertake the AIL route assessment for the delivery of the SGTs to the new GSP substation near Twinstead. The AIL report is attached as Appendix C.

4.1.2 The AIL report indicates that National Highways preferred port of delivery is Tilbury. The report further indicates that the route from Tilbury to Twinstead has been cleared by all structural authorities, but for 16 axle trailers, because 20 axle trailers have been advised as unsuitable on the M11 at National Highways East Region.

4.1.3 The AIL report indicates that Essex County Council required a structural assessment of the A131 Town Bridge at Halstead to confirm its suitability, and this is discussed further in Section 4.2. This structural assessment deemed the bridge acceptable for AIL deliveries.

4.1.4 The route from Tilbury is considered negotiable for 16 axle trailers subject to the removal of street furniture and consideration of traffic management on the A131 as detailed within the AIL report.

4.2 Review of Structural Assessment of A131 Town Bridge

4.2.1 A specialist consultant was appointed to undertake a structural assessment of the A131 Town Bridge at Halstead. The structural assessment report is attached as Appendix D.

4.2.2 An inspection of the bridge was undertaken on 9th May 2022. The report advises the structure is generally in a good condition with no defects noted which could reduce the structure's load capacity to carry AILs.

4.2.3 The structural assessment concludes that the structure is in good condition as far as was visible at the time of the inspection and is capable of carrying the full range of proposed AIL vehicles.

4.2.4 Although section 6.3 of the AIL Report indicates that final check certificates are awaited from Essex County Council, these are included in Appendix D of the structural assessment report.

Appendix A
Abnormal Indivisible Load Report for Shunt Reactors

Bramford to Twinstead Connection Project - Abnormal Indivisible Load Access for 131te Reactors to Bramford Substation

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DOCUMENT REVISIONS

Issue	Date	Details
0	29.06.22	Report
1		
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Contents

Executive Summary

The contents of this report include transport feasibility investigations into achieving access to National Grids (NG) Bramford Substation, for Special Order movements of above 150te gross loads as part of a substation development scheme. The weight considered in these investigations is 131te nett which is advised by National Grid, to be the weight of the reactors required at Bramford as part of the Bramford to Twinstead reinforcement project.

Due to the overall transport weight of the load being considered (plus carrying trailer) being in excess of 150te gross weight, the move will require a Special Order from National Highways, formally Highways England. It should be noted that Government policy is to maximise the use of water for the movement of Special Order (above 150te gross) AIL's wherever possible. National Highways require that access via the nearest available water access should be considered, as NG would be required to deliver via the nearest available marine offloading point that is practicable for AIL delivery. NG have an Agreement in Principle (AiP) from Highways England dated 11.02.20 which confirms that the HEs preferred port of delivery is Ipswich (AIP Reference 558).

The Port of Ipswich has confirmed that the port is able to accommodate transformer and reactor delivery by a variety of methods and is potentially able to offer storage of the transformer.

Route 1 via Cliff Quay/A14 Jct 55 and A1214 has been deemed the preferred route by Suffolk County Council, however a structural assessment will be required on a Suffolk County Council structure; 'Raw Water Main Culvert' on the A1214. Although the structure was crossed in 2018 with heavier loads, the most recent information provided following review by the council in 2019 requires further detailed review of this structure. An estimated cost is £10,000 but no formal budgets for assessments have been obtained. It is recommended that this assessment is progressed. National Grid should advise if they require this to be progressed.

Route 2 via Wherstead Road and the West Quay is also acceptable in terms of negotiability. However, Suffolk County Council have advised that Ostrich Creek Bridge would require an alternative approved load distribution method implemented or further assessments and therefore has been discounted when an alternative route exists.

Route 3 via Copdock and the old heavy load route is not deemed suitable in terms of negotiability due to restricted pinch points in several locations on route and Suffolk County Council structures that would require additional assessments. Suffolk County Council considers that this route should be discounted when alternatives exist.

Route 1 is therefore the preferred route to Bramford Substation from Ipswich subject to the assessment of 'Raw Water Main Culvert' on the A1214.

The route is considered negotiable for the proposed reactor transport arrangements subject to the removal of street furniture as detailed.

No specific review of on-site movement to the installation plinth is considered in this report. Detailed installation plans and methodologies to be agreed by the installation contractor. It will be necessary for National Grid to confirm that the substation site roads, including services, are able to accommodate the proposed loads. Acceptable clearance to overhead wires on the internal access road will also need to be confirmed.

The report is intended to be a summary of the Abnormal Indivisible Load (AIL) route access at the current time and is not a guarantee that the route will be cleared in the future. Specific movements will need to be assessed at the time on an individual basis. If any further information is required, it is available on request.

1. Introduction

1.1. The contents of this report include land transport feasibility investigations into achieving access to National Grids (NG) Bramford Substation for Special Order movements of above 150te gross loads associated with the future upgrade scheme.

1.2. The weight considered in these investigations is 131te nett which is advised by National Grid to be the weight of the new bulk reactors required at Bramford.

1.3. This report is a summary of the status of the current AIL access investigations to Bramford and seeks to present the situation as it currently stands. The issues highlighted in this report as risks to achieving AIL access in the future will need to be revisited and progressed as the scheme develops.

1.4. This investigation considers the possible land transport routes from the port of Ipswich. Formal movement applications will be necessary upon appointment of a haulage contractor by the transformer manufacturer.

1.5. A detailed appraisal of the technical requirements for handling transformers on site will be required as the scheme develops in the future.

1.6. The report is intended to be a summary of the AIL route access at the current time and is not a guarantee that the route will be cleared in the future. Specific movements will need to be assessed at the time on an individual basis. If any further information is required, it is available on request.

1.7. The report considers access to Bramford Substation in terms of AIL transportation only.

2. National Highways Agreement in Principle and Legislative Requirements

2.1. *Definition of Abnormal Indivisible Load (AIL)*

2.1.1. The Department for Transport, of which National Highways (NH) formally the Highways England, is a government-owned company with responsibility for managing the core road network in England, state that the strict definition of an AIL refers to a load which cannot, without undue expense or risk of damage, be divided into two or more loads for the purpose of carriage on roads and which, owing to its dimensions or weight, cannot be carried on a vehicle which complies in all respects with the 'standard vehicle regulations' these are:

- The Road Vehicles (Construction and Use) Regulations 1986 (as amended)
- The Road Vehicles (Authorised Weight) Regulations 1998 (as amended)
- The Road Vehicles Lighting Regulations 1989 (as amended).

2.1.2. All equipment should be stripped of their ancillaries before they are transported. HE will only accept that further dismantling is not required where it cannot be economically achieved due to the requirement for its construction within specific factory environments or where extremely high tolerances have to be maintained.

2.2. *Legislation*

2.2.1. Conventional heavy goods vehicles have an operating weight limit of 44 tonnes. The category known as abnormal indivisible loads (AIL) covers those vehicles where the gross weight exceeds 44 tonnes. An Abnormal Load is defined as that which cannot be carried under Construction and Use (C&U) Regulations. Items which, when loaded on the load carrying vehicle exceed the weights encompassed by the C&U Regulations, but do not exceed Special Order Permission Limits, are governed by Special Types General Order (STGO) categories 1 to 3 depending on size. Where dimensions exceed 6.1m in width, 30m in rigid length or 150 tonnes gross weight, Special Order from NH is required.

2.2.2. Special Order category AIL movements are authorised by the NH Abnormal Loads team, based in Birmingham. This is further discussed in section 2.3.

2.3. *Water Preferred Policy Requirements*

2.3.1. The Department for Transport has adopted a 'water-preferred' policy for the transport of AILs. This means that, where an application is sought for the movement of a Special Order or VR1 category load (more than 5.0m width) by road, the Department, via NH, will turn down the application where it is feasible for a coastal or inland waterway route to be used instead of road. NH advise that this decision is based on a number of factors including whether the load is divisible, the availability of a suitable route, the amount of traffic congestion that is likely to be caused and the justification for the load to be moved. The NH Abnormal Loads Team is the department responsible for the authorisation of Special Order AIL's and government policy is that the closest available port of access should be used for the delivery of such oversize items.

2.3.2. In consideration of the water-preferred policy to maximise the use of water for the movement of Special Order (Above 150te gross) AIL's wherever practicable, Wynns has sought confirmation from NH as to the port of access they would require to be utilised for the delivery of transformers and reactors to Bramford Substation.

2.3.3. NH have advised (letter dated 11.02.20, AIP reference 558) that Special Order deliveries to Bramford Substation should be considerate of access from Ipswich Docks.

3. Abnormal Indivisible Load Movements - Highways Act 1980

3.1. *Recovery of Excessive Maintenance Costs - Section 59 Agreements*

3.1.1. Section 59 of the Highways Act 1980 allows the highways authority to raise a charge against a user of the highway to cover repair works necessitated by excessively heavy or unusual loads being carried on the road by that user. This provision is typically used where the passage of heavy lorries to and from industrial premises or building sites causes excessive damage to the road, requiring expensive remedial works by the Council. Under Section 59, the Council may charge on such costs to the organisation responsible for the damage, the amount payable being calculated as the excess cost of repair compared to normal maintenance costs for the road. Rather than wait to be charged such excessive repair costs, the Council and the third party may enter into an agreement under Section 59 whereby the third party accepts liability and makes payment of an agreed sum to the Council to cover the excessive repair costs.

3.2. *The Removal and Replacement of Street Furniture*

3.2.1. Where the removal and replacement of street furniture is required for the mobilisation of out of gauge vehicles into existing sites then these are generally managed under TTRO and Street Works Legislation. These are normally, but not necessarily, organised by the haulage contractor. These requirements are generally to ensure that the supervisors and operatives are competent and that the works will be carried out to a prescribe standard with the appropriate traffic management in place. In some circumstance the Highway Authority or LA will insist that their preferred contractors will carry out such work.

4. Transport Configurations

4.1. Based on the information available to date the reactor considered within this report is assumed to be 131te nett weight as detailed in drawing no. 1069187-004 (attached in appendix 2 of this report).

4.2. At theses dimensions it is not possible to transport the Reactor within the Special Types General Order (STGO) regulations as a Category 3 load (80-150te gross) as the gross load will be in excess of 150te. It will therefore be necessary to comply with legislation regarding Special Order movements and to be delivered via the nearest port of delivery.

4.3. Based on information available at this moment in time it is assumed that the road transport configuration would of a ballast tractor pulling a 10 or 12 axle flat top modular trailer for which the trailer element would weigh in the region of 165te gross with axle loads around 16.5te.

4.4. There are numerous haulage contractors with equipment able to carry the reactor in the UK. This would be expected to be on a 10 or 12 axle flat top modular trailer.

4.5. It is expected that competitive heavy haulage procurement will be feasible for the transport of the reactors on flattop trailers.

4.6. Two trailer arrangements were submitted to structural authorities for comment in terms of their suitability on the potential access routes from Ipswich Docks via the NH Abnormal Loads Team in Birmingham for formal consultation as part of the Special Order approval process. These were for 10 axle trailers at 3m and 3.6m wide bogie widths and gross weights of 162.4te and 168.1te respectively. The responses to these investigations are discussed in Section 7.

4.7. The specific trailer details are not included in this report due to the information being commercially sensitive to each haulage contractor and thus it is recommended it is not forwarded to other parties. However, specific trailer information can be made available to NG under separate cover if required.

5. Marine Access

5.1. *Port of Ipswich*

5.1.1. No specific revaluation of marine access at Ipswich has been undertaken as part of this report as it has been recently proven for heavy load delivery to both Burwell Main Substation in 2019 and 2021 and the East Anglia ONE offshore wind farm onshore Burstall substation in 2018. However, a review of file information is shown below for reference.

5.1.2. The Port of Ipswich is situated on the River Orwell to the south of the town. The maximum published size of vessel for the port is 155 metres overall length, no restrictions with regard to beam, and 8.4 metres draft. There are no height restrictions.

5.1.3. The port can accommodate all types of vessels could be accommodated at the West Bank Quay including coaster vessels, geared vessels and Ro-Ro vessels although they would need to meet with ground loading limitations of 5te/m^2.

5.1.4. West Bank Quay also offers a Ro-Ro link span with a safe working load limit of 220 tonnes. It has not been confirmed as to whether this is adequate for the loading of the transformer and flattop transport configuration. Ro-Ro operations would be expected to have to be undertaken at the quay rather than on the link span although further investigation of the link span option could be considered if a suitable road route existed, which at present it does not (see Section 7).

5.1.5. Alternatively, heavy lift operations for transformers have previously been carried out at Cliff Quay on the eastern side of the port from Coaster vessels, however a stand-off of 22m from the quay edge is required for any heavy lift cranes due to the construction of the suspended quay. Cliff Quay is that used for the Burwell Main SGTs in 2019 and 2021.

5.1.6. The port also has areas where short term storage of a transformer could be undertaken to aid project planning associated with onward road movement to site. The port was used recently to store the Burwell Main SGT delivery from Cliff Quay Ipswich to Burwell Main in June 2021 following initial delivery to Ipswich in 2020.

5.1.7. There are issues in terms of onward road routes outside of the port environment that impact on whether the east or west area of the port are used and these are discussed in Sections 7 and 8.

6. Historical Information

6.1. Records indicate that the last recorded Special Order AIL movement (in excess of 150te gross) to the new adjacent Burstall substation to Bramford, for the East Anglia ONE Offshore Project was in 2018. It utilised what is known as route 2 within this report and had to deploy bridging units to cross Ostrich Creek Bridge with a 28 axle girder frame trailer. This is because the heavy transformers, in excess of 200te nett transport weight, were not able to obtain structural clearance across the Orwell Bridge that provides access from the east side of the River Orwell.

6.2. Reactors of circa 116te nett weight were also transported from West Quay to Burstall Substation in 2018 on 5bed5 trailers.

6.3. The route out of Cliff Quay to the A14/A12 junction was used in June 2021 for the delivery of a SGT to Burwell Main on an 18 axle girder frame trailer. This is further discussed in Section 7 as the first section is the same as that envisaged for NG Bramford SGT loads.

7. Structural Route Information

7.1. *Route 1 from Ipswich Cliff Quay*

7.1.1. The routes considered in the structural checks to Bramford Substation are shown below and illustrated in Map 1 appended to this report. These are based on the route used to Burwell Main Substation in 2019 and 2021 in terms of exiting Ipswich Cliff Quay to the A14 and also the route used in 2018 to Bramford to access the adjacent Burstall Substation.

Proposed Route 1
Exit ABP Ipswich via Gate Number 1 onto Cliff Road
Turn right onto Holy Wells Road, Landseer Road
Turn right Nacton Road
Continue A1189
Turn left A14 Eastbound to A12 roundabout to circumnavigate and return A14 west
Continue A14 Orwell Bridge
Exit A14 Junction 55 and turn right onto A1214
Continue A1214
Turn left A1071
Turn right B1113
Turn left Bullen Lane *(Note 1. Load may need to drive past Bullen Lane and reverse into the turn to access the substation)*
Continue to Bramford Substation.

7.1.2. Route 1 has been structurally cleared by the following structural authorities for 16 and 20 axle girder frame trailers:

- National Highways East Region
- Network Rail
- Canals & Rivers Trust
- National Highways Historic Railways Estate

7.1.3. Suffolk County Council advised during meetings and in various emails that route 1 is their preferred option. It is however recognised that this depends on the suitability of the A14 Orwell Bridge which is managed by National Highways East Region and which is discussed in the following sections.

7.1.4. National Highways East Region has advised that in regards to Orwell Bridge on the A14, the loads are approved although cautions and specific requirements are necessary. The following caution to be adhered to when crossing;

> *'Caution: Passage of the abnormal load movement should be allowed on Orwell Bridge with the following caveats: The load uses the south box (west-bound carriageway). The load is the only vehicle on the west-bound carriageway over the bridge. The load is positioned symmetrically over the centreline of the box girder. The box centreline is calculated to be in lane 1, offset by 1.115m from lane 1 / lane 2 dividing line'.*

7.1.5. It should be noted that the bridge was crossed with a Hyundai circa 178te transformer in June 2021 and this required the bridge to be closed to other traffic. It is assumed the same principles will apply to future movements. This has significant traffic management implications as the structure is a major multi span viaduct crossing over the River Orwell. The exact traffic management, police escorts and requirements of NH East Region will need careful planning by the appointed haulage contractor. Adequate time should be allowed for in the planning of this process.

7.1.6. As detailed previously, in 2018 loads for Burstall Substation were not able to secure access over Orwell Bridge and exited Ipswich Docks Western Terminal onto A137 Wherstead Road as per Route 2 shown in Section 7.2.

7.1.7. Suffolk County Council advised that routes 1 and 2 are affected by a 710 Raw Water Main Culvert which is a structure on the A1214 just north of Copdock Interchange which is currently restricted to STGO 3 vehicles pending further investigations. An assessment is required to confirm the proposed load required at Bramford can cross. These have been advised as being able to be undertaken by a third party subject to Suffolk's specifications and technical approval.

7.1.8. Although it was agreed that the Burstall Substation loads had crossed this structure in 2018 it is now identified as needing assessment following a structures review and routine Principle Inspection undertaken by Suffolk County Council in February 2019. Suffolk County Council have provided the structures review for reference, and this is included in Appendix 4, with the main points summarised below.

7.1.9. 710 Raw Water Main Culvert is a 4.2m diameter pipe of 45m length that runs under the carriageway at 45°. Available design information suggests the structure is designed to 45HB units and for AILs. The concern is the inspection chamber and whether accidental wheel loading could be a problem. Although it is not expected that this structure will be restrictive to the proposed loads, Suffolk County Council do not have the necessary paperwork to prove this and although they are content that there is no risk for day to day highway traffic. Before any future AIL is permitted to cross, Suffolk County Council will require an assessment and what they term a *"structures review"* to be undertaken by a suitable qualified consulting engineer. This could be either their own consultants, Aecom, or another third party. Suffolk County Council would also require additional payments for acting as the Technical Approval Authority (TAA) to clarify the method of assessment and sign it off as the asset owner in line with current bridge design standards.

7.1.10. The 2019 structures review that has been provided for reference indicates that structural assessment is not in itself sufficient at present as there is uncertainty on the condition of the steel pipe and it is necessary for an inspection to confirm the thickness and condition of the corrugated steel. Investigatory small diameter core drilling could be undertaken if an ultrasound survey cannot give consistent steel thickness measurements. Once this inspection is completed an assessment to confirm loading capacity of the steel I-beams and the precast concrete cover slabs at the inspection chamber can be undertaken. Finally, as no design certification is available for the structure an assessment to provide a signed assessment certificate is required. This assessment could also confirm the Special Vehicle (SV) rating of the structure.

7.1.11. No specific assessment costs have been advised or sought for this work but an estimated cost of £10,000 should be used for budgetary purposes. It is recommened that this assessment is progressed to confirm access in advance of the procurement of the reactors to confirm the route remains feasible. NG should advise if they wish for a detailed cost and proposal for inspection and assessment to be provided.

7.1.12. There are no Suffolk County Council structures of concern on the section from the port to the A14. There are also no other Suffolk County Council structures on A1071, B1113 and Bullen Lane.

7.1.13. The B1113 at Sproughton would require parking restrictions and need to remove parked cars. This would be facilitated under Temporary Traffic Regulation Order (TTRO). All associated costs including publication of TTRO notices and traffic management would need to be paid for by the applicant.

7.1.14. Suffolk County Council advises that they require a TTRO in order to legally overcome the 7.5te environmental weight limit on the B1113.

7.1.15. Suffolk County Council advises that they consider the B1113 is the heavy load route and would expect this to be used. Wynns questioned whether there was any possibility of approaching from the A14 to the north at Junction 52 and Suffolk County Council advised that this was looked at before and they cannot agree to it. The old county salt depot used to be on the industrial estate and as such the rail and river bridges have had a lot of salt leading to deterioration of concrete, so their condition is uncertain. Although 45HB design in 1970s, the River Bridge has now has SV100 capacity and suffers from high chloride levels and the condition is poor and requires intrusive tests done to confirm the status of the concrete and then to determine a new bridge capacity.

7.1.16. In addition, there is a rail bridge, which is at a significant skew, and is in long term plan for inspection and assessment but Suffolk County Council are struggling to get a track passion from Network Rail to do the necessary checks and they have no current capacity data and will not allow any AILs this way.

7.1.17. At present Suffolk County Council would not wish to consider this route when the B1113 heavy load route is available from the south and it should be discounted where other access options remain suitable.

7.1.18. Norfolk and Suffolk Police, who work as a combined force for roads policing across the two counties, were also approached for comment on the routes submitted for consultation and a meeting was held with Norfolk and Suffolk Police on 30.06.21 to inform them of the proposals. The draft notes have been circulated to NG previously and are not reproduced in this report. They are familiar with requirements for Bramford from the 2018 deliveries to the Burstall Substation.

7.1.19. An updated AIL policy document providing general advise on the guidance for AIL movements in the two counties was produced by Norfolk and Suffolk Police in February 2021 and this is attached within Appendix 5 for information and reference.

7.1.20. No specific issues have been identified by the police although it is expected that a police escort would be required for the from Ipswich Docks to site due to their width being 4.7m and the weight being in excess of 150te with private escort arrangements also in place and it is recommended that further discussions are undertaken with respect to confirming escort requirements prior to deliveries with the police forces.

7.2. *Route 2 from Ipswich Western Terminal*

7.2.1. Route 2 was used in 2018 to Bramford to access the adjacent Burstall Substation for transformers of circa 250te nett weight on 28 axle girder frame trailer which were not able to secure route clearance over Orwell Bridge.

Proposed Route 2
Exit ABP Ipswich via West Gate on to Wherstead Road
Continue over Ostrich Creek Bridge
Turn right A137
(Note 2. Expected that it will be necessary to travel on A14 eastbound in contraflow from A137 to A14/A1214 interchange to avoid A137 junction bridge.)
Continue A14 eastbound carriageway in contraflow under road closure
Turn right A1214 and join route 1
(Note 3. A shunt is required at the A14/A1214 interchange to get from the A14 east entry slip road in contraflow to the A1214 correct direction.)

7.2.2. Route 2 has been advised by Suffolk County Council as being subject to an assessment on 1007 Ostrich Creek Bridge on Wherstead Road as the current structural capacity of is restricted to SV80 (30 HB) and it is not suitable for the proposed loads to cross without remedial measures being agreed.

7.2.3. In 2018, Allelys moved a 250te transformer to the new Burstall Substation, adjacent to Bramford, for the East Anglia ONE Offshore Project. For this movement, Suffolk Council rejected the movement over Ostrich Creek Bridge in conventional fashion due to the above 80te restriction and bridge rafting equipment had to be commissioned in order to achieve access out of Ipswich West Bank Docks. This was only approved following detailed structural assessment of Ostrich Creek Bridge and all temporary bridging arrangements. This arrangement, which utilised specially constructed beams of approximately 28m length, is shown being used over the bridge for the 2018 movement in the below photograph.

Figure 1.
Allelys moving a 250te transformer over Ostrich Creek Bridge in 2018 on 28 axle trailer using temporary bridging arrangement. Courtesy of Allelys Heavy Haulage.

7.2.4. Reactors of circa 116te nett weight were also transported from West Quay to Burstall Substation in 2018 on 5bed5 trailers. It is understood that following detailed assessment these loads were able to cross Ostrich Creek Bridge conventionally without the temporary bridging arrangements being in place. At present Suffolk County Council have not confirmed this remains suitable for the 131te reactor loads and the temporary arrangement would probably be necessary if this route were to be used although this could be reconfirmed with a specific load assessment for the reactor delivery vehicles.

7.2.5. Although Suffolk County Council have said they would allow this to be undertaken it would only be considered if all other routes are deemed unsuitable which will depend on the status of Orwell Bridge as detailed in 7.1. The council considers the works required and associated traffic management necessary under TTRO restrictions an inconvenience to other road users and the impact of the temporary crossing of Ostrich Creek Bridge a significant impact that should be avoided if at all possible.

7.2.6. The comments of Suffolk County Council in respect to 710 Raw Water Main Culvert on the A1214 discussed in 7.1 also apply on route 2.

7.2.7. Historical information indicates that the bridge at the A137/A14 junction, where the load would need to cross to access the westbound carriageway is of insufficient capacity to accommodate AILs. This was confirmed for the 2018 Burstall Substation loads which were not able to use the junction bridge and which had to contraflow the A14 westbound carriageway in an eastbound direction between A137 and A1214. It has not been specifically explored in this report, as Route 1 has been confirmed as available in terms of Orwell Bridge. However, it is assumed the same limitation will apply. This means that it is necessary to contra flow the A14 eastbound carriageway from the A137 to the A14/A12/A1214 Copdock Interchange. This would require significant traffic management and closure under TTRO from NH East Region to achieve.

7.3. *Route 3 from Ipswich Cliff Quay*

7.3.1. Route 3 is an alternative to using the A1214 and A1017 to access the B1113 and utilises part of the historical AIL route to Bramford from the A12. It does not avoid the issues on exit from Ipswich Docks Cliff Quay discussed in Section 7.1 or from Ipswich Docks Western Terminal discussed in Section 7.2. Route 3 is the historic DfT Heavy Load Route 82 (HR82) and is described below.

Proposed Route 3
Exit route 1 at A14 Jct 55 and turn left on to A12 southbound
Exit A12 Jct 32b on to London Road
Turn left Chapel Lane
Continue Swan Hill
Continue B113
Continue as Route 1.

7.3.2. Suffolk County Council has advised that two structures are currently restricted to STGO 3 vehicles; 388 Washbrook Flood Culvert and 709 Washbrook Bridge and an assessment would be required for both if this route were progressed further. In addition to this they would also require pre and post movement inspections on 493 S of White Elm Copdk, a small span drainage asset. Route 3 is also not deemed suitable in terms of negotiability by Suffolk County Council due to restricted pinch points in several locations on route

Suffolk County Council considers that this route should be discounted when alternatives exist.

8. Route Negotiability Information

8.1.1. The route survey undertaken included 2 options for exiting the port of Ipswich; via Cliff Quay (route 1) and West Quay (route 2). Wynns also surveyed the historic heavy load route (route 3) which was discounted due to limited negotiability in places and structural limitations and therefore no notes and photographs have been included on route 3, although additional information is available upon request.

8.2. *Proposed Route 1*

8.2.1. The exit from Cliff Quay has in the past required the load to remove the fence next to the main security gate due to the width of the vehicle limited access on the main access road. It is understood the 2021 Burwell Main transformer used the main exit gate road. There are therefore a couple of options for egress depending on the final trailer width selected for movement and the exact requirements will be agreed with the port at the time of requirement by the appointed haulage contractor. No major issues expected for 10 axle flattop trailers.

Photograph 1
Cliff Quay Port exit. Whilst general port traffic exits between the gate posts, the exit can be of insufficient width for the transformer delivery vehicle. No major issues expected for 10 axle flattop trailers transporting the reactor.

8.2.2. In the past, loads have passed left of the gate post, then exited through the chain link fence line. Temporary removal of fence required. Alternatively, some loads can continue on the main road egress with caution depending on final transport width. It is understood that the June 2021 SGT to Burwell Main exited the gate in conventional fashion.

Photograph 2

Cliff Quay port exit. Vehicle approaches from right of photograph, moves towards camera and exits the port through fence shown on the right or through main gate if sufficient width depending on transport arrangement selected for movement. No major issues expected for 10 axle flattop trailers transporting the reactor.

Photograph 3

Right turn on to Toller Road. Vehicle moves away from camera. Parking restrictions required as HGVs can often be parked here waiting to access the port.

Photograph 4

Right turn on to Landseer Road. Negotiable. Parking restrictions required as HGVs can often be parked here waiting to access the port.

Photograph 5
South on Landseer Road. Vehicle moves away from camera.

Photograph 6
South on Landseer Road. Vehicle moves away from camera. Centre island street furniture may need to be removed depending on the final transport configuration selected for movement. No major issues expected for 10 axle flattop trailers transporting the reactor.

Photograph 7
Residential area of Landseer Road. Parking restrictions will need to be put in place.

Photograph 8
Residential area on Landseer Road which requires more parking restrictions.

Photograph 9
Landseer Road/Nacton Road Roundabout. Vehicle moves away from camera, turning right on Nacton Road. Socketed centre island furniture allows for easy removal for the movement in coordination with Suffolk County Councils highways team. No major issues expected for 10 axle flattop trailers transporting the reactor.

Photograph 10
Demountable furniture on the Landseer Road/Nacton Road Roundabout.

Photograph 11
Demountable furniture on the Landseer Road/Nacton Road Roundabout.

Photograph 12
Reverse view of Landseer Road/Nacton Road roundabout. Vehicle enters photo from the left, turns right, removing the socketed furniture on Landseer Road centre island, moves towards camera, contraflowing roundabout on to opposite side of Nacton Road. No major issues expected for 10 axle flattop trailers transporting the reactor.

Photograph 13
Nacton Road/Maryon Road Junction. Vehicle moves away from camera, continuing Nacton Road. No major issues expected for 10 axle flattop trailers transporting the reactor.

Photograph 14
Centre island furniture on Nacton Road. Vehicle moves away from camera. No major issues expected for 10 axle flattop trailers transporting the reactor.

Photograph 15
Nacton Road/A1189 Roundabout. Vehicle moves away from camera, continuing A1189. Negotiable.

Photograph 16
A14 Eastbound Entry Slip Road. Vehicle moves away from camera and joins the A12 eastbound. Negotiable.

Photograph 17
Circumnavigate Seven Hills Interchange onto A14 westbound. Negotiable.

Photograph 18
Return A14 westbound. Vehicle moves away from camera. Negotiable.

Photograph 19
A14 westbound over Orwell Bridge. AIL to be only vehicle on bridge and NH England East Region road closure required to be managed by Suffolk Police as discussed in Section 7 under TTRO.

Photograph 20
A14 Junction 55 exit roundabout. Copdock Interchange. Vehicle moves away from camera, turning right on the A1214. Negotiable.

Photograph 21
Copdock Interchange bridge over A14 at junction 55. Cleared for the NG loads investigated within this report.

Photograph 22
Copdock Interchange. Vehicle enters from behind camera and drives forward on to the A1214 seen centre right of photograph.

Photograph 23
A1214 Scrivener Drive Roundabout. Vehicle moves away from camera, continuing straight on the A1214.

Photograph 24
A1214/A1071 crossroads. Vehicle moves away from camera and turns left A1071. Full occupation of carriageway required. Negotiable.

Photograph 25
Reverse view of left turn from A1214 on to A1071. No major issues expected for 10 axle flattop trailers transporting the reactor.

8.2.3. The Wynns survey team were in the area beginning of June 2021 and noticed a new road layout under construction on the link from A1214 to A1071. This was investigated with Suffolk County Council, who have advised (email 21.06.21) that the works formed part of the 'Wolsey Grange highway improvement scheme' and when completed, will have widened part of the A1071, and in turn should improve negotiability for the abnormal load vehicle turning from the A1214 on to the A1071. In addition to this, the traffic signal posts are socket mounted too to allow for removal if required.

8.2.4. No design drawings have been obtained by Wynns as the scheme has yet to be completed, but it is not thought to cause any negotiability issues for the loads discussed within this report.

Photograph 26
Reverse direction on A1071 over A14. Vehicle moves towards camera. The bridge has been cleared for Special Order loads to Bramford Substation.

Photograph 27
Swan Hill Roundabout. Vehicle enters photo bottom right, moves away from camera, turning right on to B1113. The turn should be undertaken in contraflow to aid access although the roundabout has been accessed by 28 axle trailers in 2018.

Photograph 28
Full occupation of the carriageway necessary on most of B1113 and careful traffic management including liaison with local residents and business in respect to movement times as the full occupation of the road will be required by the AIL. A TTRO is also needed to overcome 7.5te environmental weight restriction.

Photograph 29
Full occupation of the carriageway necessary on most of B1113. No parking restrictions to be put in place through the village of Bramford.

Figure 2.
2018 delivery of reactors to Burstall Substation on B1113. *Courtesy Allelys Heavy Haulage.*

Photograph 30

Left turn from Loraine Way B1113 on to Bullen Lane. Vehicle moves away from camera and turns left. SGTs on girder frame trailers have in the past continued past the junction, then turned onto Bullen Lane, either in reverse or with the tractor units turned around, turning right on to Bullen Lane.

Photograph 31

Reverse view of turn on to Bullen Lane. Note the fence on the right (inside of turn after reverse) was installed prior to 2018 28 axle trailer deliveries following improvements to the inside of the junction.

Photograph 32

Reverse view looking back to B1113. Vehicle moves towards camera.

Figure 3.
2018 delivery of reactors to Burstall Substation turning left from B1113 to Bullen Lane. *Courtesy Allelys Heavy Haulage.*

8.2.5. The 2018 delivery was undertaken on a 5 bed 5 trailer which is a larger trailer than the 10 row flattop trailer considered here. This was due to the overall height of the transformer required a bed trailer to remain under 5m standard motorway and trunk road running height. 10 axle trailer will be able to negotiate the turn although it is recommended that temporary packing or plating of the kerbs and verge is undertaken.

Photograph 33
West on Bullen Lane. Vehicle moves away from camera. Tree pruning may be necessary depending on time of movement and seasonal growth.

Photograph 34
West on Bullen Lane. Vehicle moves away from camera. Tree pruning may be necessary depending on time of movement and seasonal growth.

Photograph 35
Gate to National Grid private access road. Load moves away from camera. Negotiable with removal of gate post.

8.2.6. No specific review of site access is discussed and the survey ended at the substation gate. Wynns do have file information on site in respect to access to the exiting SGT2 which may be used to inform reactor access depending on where the new units are to be installed within the substation.

8.3. *Proposed Route 2*

8.3.1. Proposed route 2 via West Bank and Wherstead Road has been discounted due to the additional requirement of an assessment and temporary bridging that is required over Ostrich Creek Bridge by Suffolk County Council and discussed in 7.2. However, the main points of interest are shown below for reference.

Photograph 36
Port Exit at West Bank. Gate width 5.4m. Negotiable.

Photograph 37
Approach to roundabout on Wherstead Road. Vehicle moves away from camera, turning left Wherstead Road.

Photograph 38
There is an alternative gate on the West Bank further North on the A137

Photograph 39
View looking back to alternative gate on West Bank.

Photograph 40
Reverse on the A137. Vehicle moves towards camera if using alternative port gate.

Photograph 41
Roundabout with main port entrance on Wherstead Road. Vehicle moves away from camera, continuing straight on Wherstead Road. If main entrance is used then vehicle would enter from the left of photo, turn left continuing Wherstead Road.

Photograph 42
Bridge on Wherstead Road over Ostrich Creek. Vehicle moves away from camera. It is expected that bridging units will be required under full road closure as discussed in Section 7.2 for access to be permitted. Exact requirements for bridging and associated traffic management to be agreed with Suffolk County Council.

Figure 4.
Allelys moving a 250te transformer over Ostrich Creek Bridge in 2018 on 28 axle trailer using temporary bridging arrangement. Courtesy of Allelys Heavy Haulage. Note AIL has also crossed over to the northbound carriageway over the kerbed central reservation prior to crossing the bridge.

Photograph 43
A137/Wherstead Road Roundabout. Vehicle enters photo from the left, turns right and moves towards camera.

Photograph 44
A14 exit sliproad. Vehicle moves towards camera, contraflowing exit slip road to avoid the A137 bridge over the A14 and enters A14, travelling Westbound in the eastbound carriageway, requiring crossover.

Photograph 45
Westbound carriageway of the A14. Vehicle contraflows, moving towards camera.

Photograph 46
Westbound carriageway of the A14. Vehicle contraflows, moving towards camera.

8.3.2. The vehicle exits the A14 via entry slip road to A1214, in contraflow, travels around the roundabout on to the exit slip road, where the tractor units are turned around, before the load could travel in conventional fashion up the northbound side of the A1214. Exact shunt requirements to be confirmed by haulage contractor.

8.3.3. Route 2 then joins the A14 and route 1 to continue to site as previously discussed.

8.4. *Proposed Route 3*

8.4.1. The historic route to site via Copdock has been discounted due to several tight pinch points on the route, including access from A12 westbound to London Road at White House. Suffolk County Council also do not wish this route to be considered further if others exist as they do not consider it acceptable due to the limited negotiability and impact on local residents and community.

8.4.2. In addition to this, Suffolk County Council have advised of 2 structures which are currently restricted to STGO 3 vehicles; 388 Washbrook Flood Culvert and 709 Washbrook Bridge. They have also advised of pre and post movement surveys to be required for 493 S of White Elm Copdk.

8.4.3. It is for these reasons the route has been discounted and no notes or photographs have been included. Further information is available upon request.

9. Summary and Conclusions

9.1. The NH Abnormal Loads Team has provided Agreement in Principle (AIP) for Bramford Substation and have stated that their preference is for access to be via Port of Ipswich.

9.1. Ipswich Port remains suitable for the shipment of the reactors via various methods of offloading with offloading facilities on both the western and eastern terminals of the River Orwell.

9.2. Route 1 from the Port of Ipswich has been advised as the preferred route by Suffolk County Council subject to one confirmatory structural assessment on Raw Water Main Culvert on the A1214. An inspection and *"structures review"* to inform an assessment are required on this structure. Although the structure was crossed in 2018 with heavier loads, the most recent information provided following review by the council in 2019 requires further detailed review of this structure. An estimated costs is £10,000 but no formal budgets for assessments have been obtained. It is recommended that this is progressed to confirm access prior to delivery. NG should advise if they require this to be progressed.

9.3. The route from Ipswich is considered negotiable subject to the removal of street furniture although a TTRO will be required to enable traffic restrictions to be in place on the B1113 in Sproughton.

Appendix 1

Maps

Key

Blue line	Route 1 from East Quay
Orange line	Route 2 from West Quay
Green line	Route 3 via Copdock
Yellow circle	Point of Interest
Red circle	Bramford Substation

Rev	Date	Amendments:
B		
A		
0	29.06.22	First Issue

Revisions

Wynns Ltd. Independent Transportation Consultants.

Shaftesbury House, 2 High Street, Eccleshall, Stafford, ST21 6BZ. Tel: (01785) 850411

Client: nationalgrid East Coat Onshore National Grid

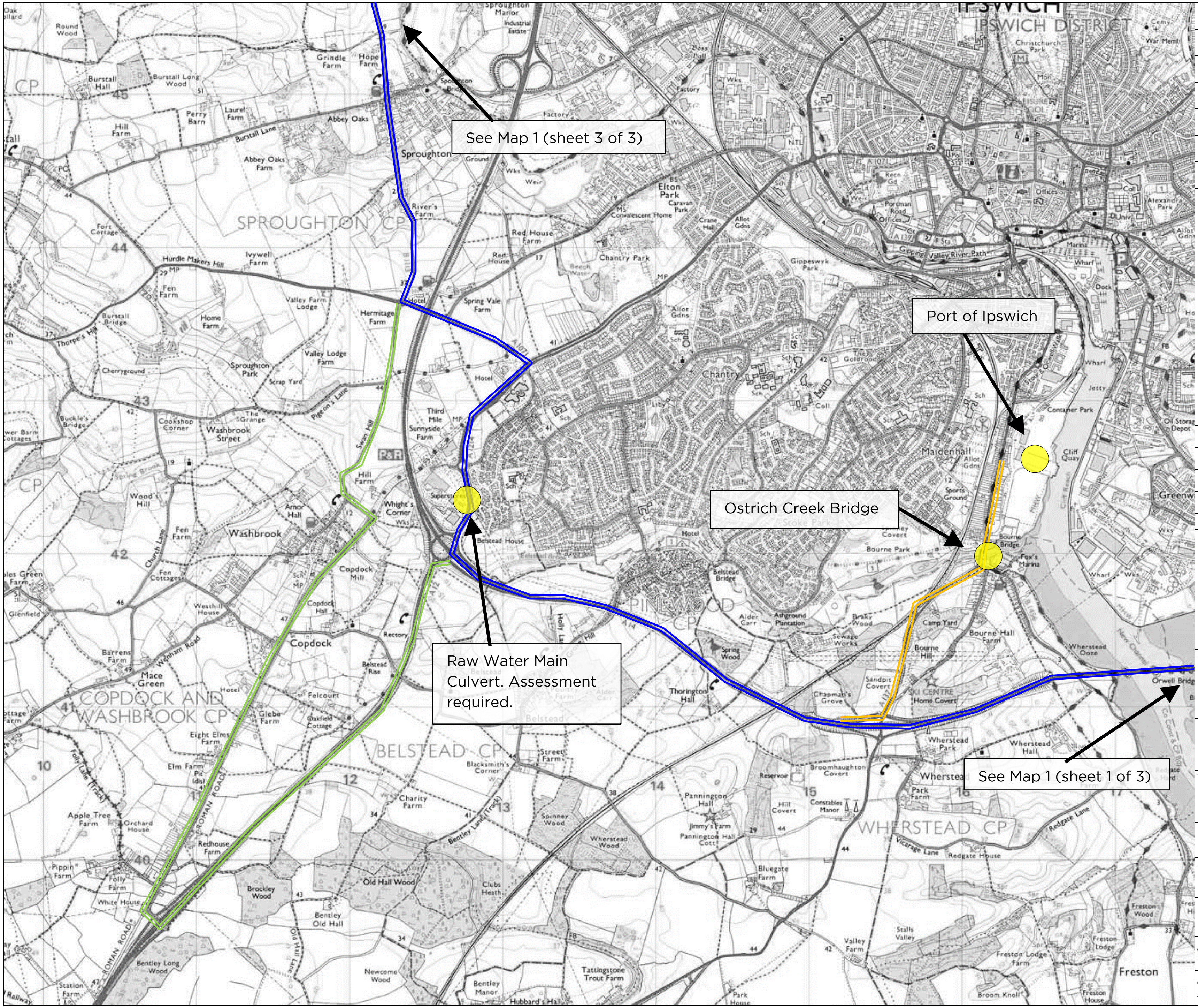
Project: Bramford to Twinstead Bramford Reactor

Title: Map 1 – Routes from Port of Ipswich

Drawing Status: Final Report

Scale (A4):	Drawn by:	Checked by:
NTS	ARP	PAGW

Ref No.:	Sheet:	Rev.:
21.1030.Map1	1 of 3	0



Key

Blue line	Route 1 from East Quay
Orange line	Route 2 from West Quay
Green line	Route 3 via Copdock
Yellow circle	Point of Interest
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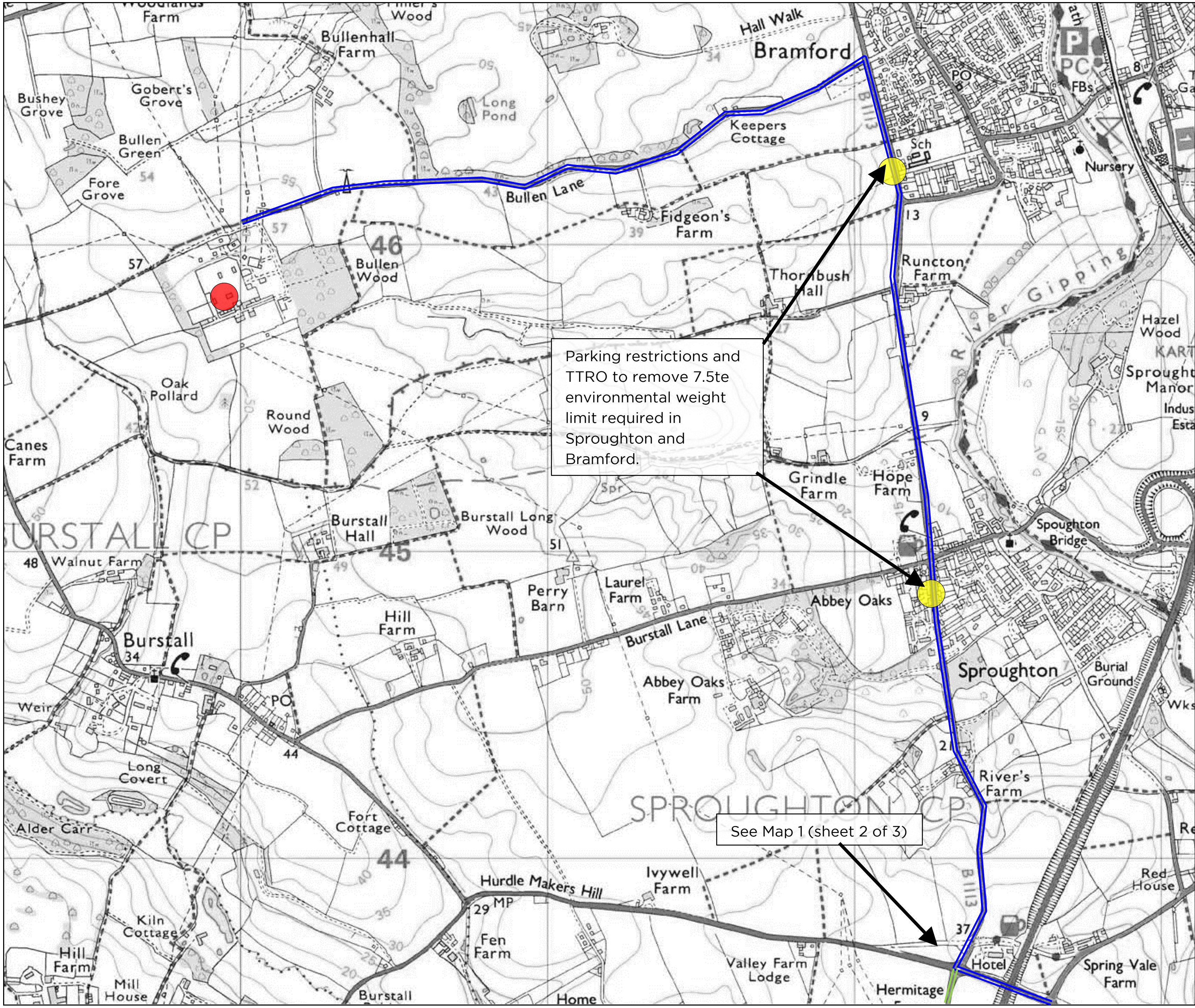
Ref No.:	Sheet:	Rev.:
21.1030.Map1	2 of 3	0



Key

Blue line	Route 1 from East Quay
Orange line	Route 2 from West Quay
Green line	Route 3 via Copdock
Yellow circle	Point of Interest
Red circle	Bramford Substation

Rev	Date	Amendments:
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Client: East Coat Onshore National Grid

nationalgrid

Project: Bramford to Twinstead Bramford Reactor

Title: Map 1 – Routes from Port of Ipswich

Drawing Status: Final Report

Scale (A4):	Drawn by:	Checked by:
NTS	ARP	PAGW

Ref No.:	Sheet:	Rev.:
21.1030.Map1	3 of 3	0

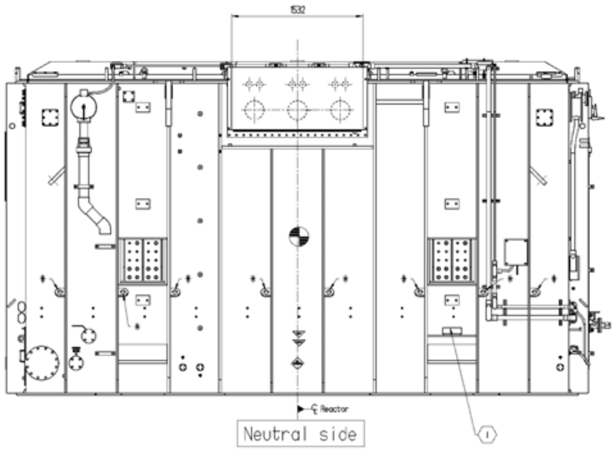
Appendix 2

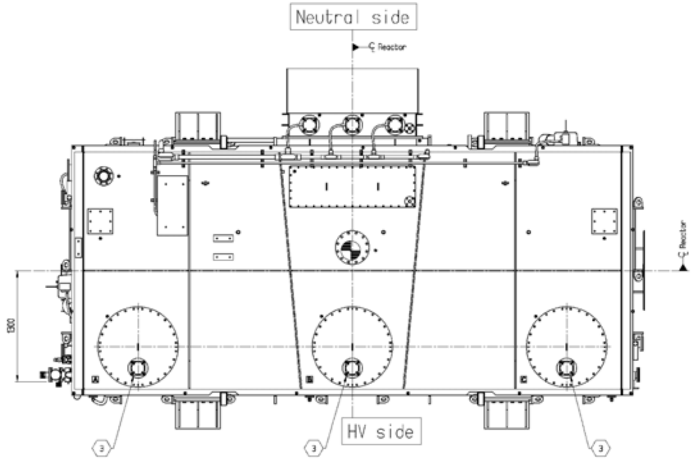
Drawings

It is not allowed to weld on the reactor tank to secure load during transport.

Jacking of the reactor unit is only allowed on the jacking points.

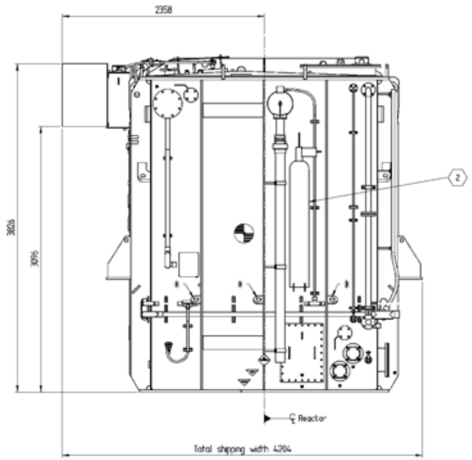
Jacking - and lifting points are marked red.

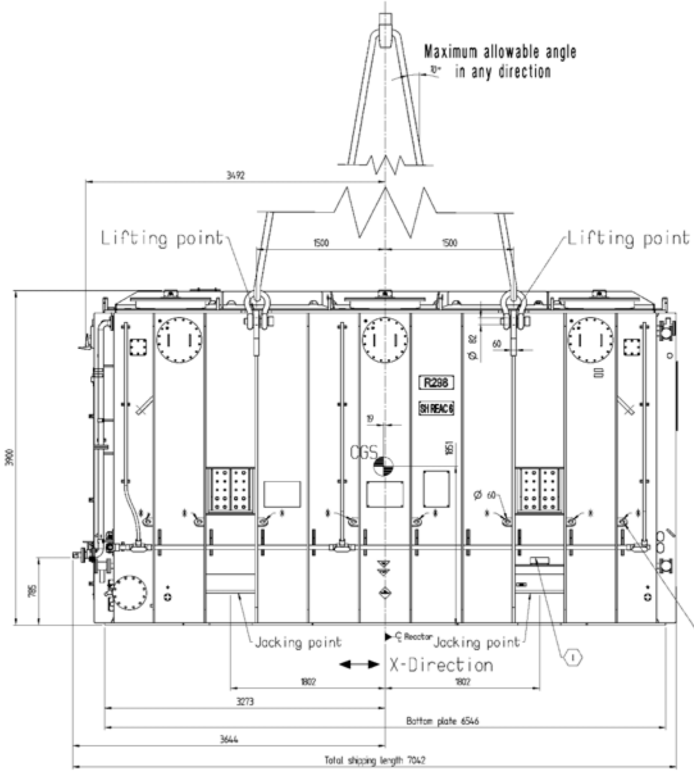




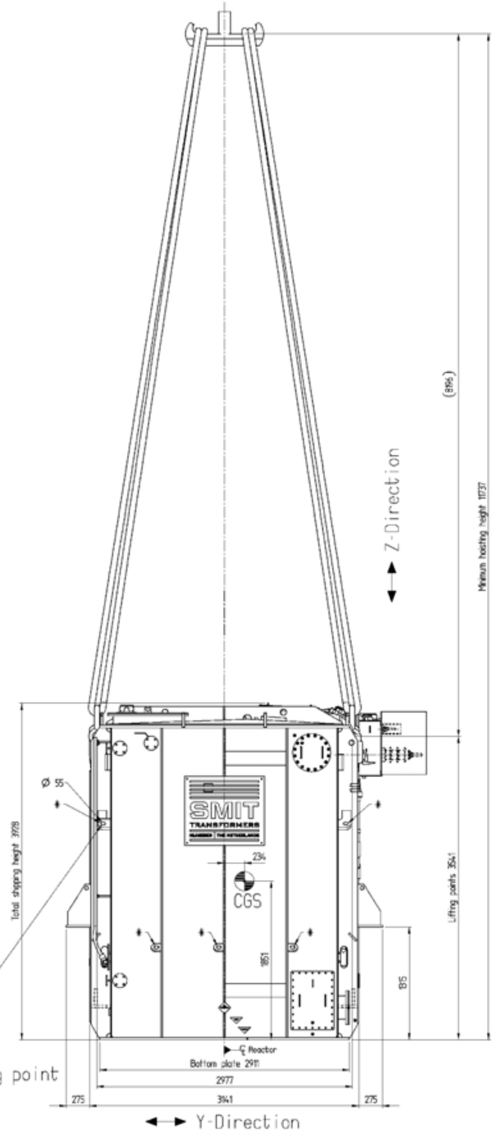
Shipping mass (without oil): 131.100 kg

Maximum allowable accelerations during transport
X-dir. 0,6g
Y-dir. 0,6g
Z-dir. 0,6g





HV side



Item:	Number of parts:	Temporary item:
1	2	Shockrecorder
2	1	Dry air bottle
3	3	SFRA

WARNING: Remove temporary items before engergizing

CGS = Centre of Gravity for Shipment

Issue	H		Masses and center of gravity changed.
Drawn	P.Eikholt		
Checked	R.Mekkering		
Approved / Date	M.van.Woerkom	20-Dec-2016	

Royal SMIT Transformers B.V.
Groenestraat 336
6531 JC Nijmegen
The Netherlands

Laing O'Rourke Construction Ltd.	Bridge Place, anchor Boulevard, Admirals Park, Crossways, Dartford, Kent, DA2 6SN
Laing O'Rourke Construction Ltd contract reference number	S-C3679/000006
Laing O'Rourke Construction Ltd drawing number	50_LOR_0002
SMIT Transformer number	3230937 for shunt reactor 312000616-10
Project number: 312000616	Article number: LT_SHUNT_DELIV

Drawing Title

Shipment
Shunt reactor
200 MVAr - 400 kV
Wimbledon Substation SHR6

Smit K-00-0-001.1e CAD drw.: Not to Scale	Form A0
Sheet No.	1
No. of Sheets	1
Originator Drawing Number 1069187-004	Issue H

Appendix 3

National Highways Correspondence

Our ref: HE REG 558
Your ref: Bramford Substation

Laura Blundell
Senior Movement Planner
9th Floor
The Cube
199 Wharfside Street
Birmingham B1 1RN

Direct Line: 0300 470 6155
11th February 2020

Andy Pearce
Wynns Limited
Shaftesbury house
High Street
Eccleshall
Staffordshire
ST21 6BZ

Dear Andy,

AGREEMENT IN PRINCIPLE: - AIP 558 BRAMFORD SUBSTATION

Further to your email dated 11th February 2020, requesting provision of an AIP for future abnormal load moves into the Bramford Substation.

I can confirm that an AIP can be provided for the movement of a Transformer from Ipswich Docks, to Bramford Substation, the provisional dimensions, weight and number of pieces as detailed below.

1nr Transformer with an approximate weight of 178te (approx. 270te gross on a 16 axle trailer).

Delivery is expected in 2021.

This will of course be subject to formal application nearer the time at which Highways England will consult with all relevant parties and take into consideration their views and requirements.

Consequently, any Special Order issued is likely to include specific requirements relating to the day(s) on which movements will be authorised. The Special Order may also prescribe specific times during the day or night when movement will be permitted (which may take into account seasonal variations in traffic) in order to minimise traffic congestion, and disruption to other road users.

The AIP is valid for a period of at least seven years but with the proviso that should nearer, suitable access become apparent, or feasible in that time, National Grid would undertake to investigate and assess its potential for future use, with a view to that new facility becoming the agreed access.

It would be helpful if you could quote the above AIP reference when applying for the Special Order permits.
I trust this information is sufficient for your purposes, but please do not hesitate to get in touch if you require anything further.

Yours sincerely

Laura Blundell

Laura Blundell
Senior Movement Planner
Abnormal Loads
Email: [redacted]

Appendix 4

Suffolk County Council Correspondence and Bridge Data

Andy Pearce

From: Amanda Mays [redacted]
Sent: 20 April 2020 17:20
To: Andy Pearce
Cc: Stuart Heald (SCC)
Subject: RE: AIL Access to Bramford Substation

Apologies for the delay in responding Andy,

As Stuart suggests we don't have any way to know or effectively assess the culverts load bearing capacity. I think the suggestion of a pre and post movement survey is probably the most practical solution.

regards

Amanda Mays
Asset Manager (Drainage, Footways, Street Furniture, and Soft Estate)

Suffolk Highways I Phoenix House, Ipswich, IP1 5NP
Mob. [redacted] I www.suffolk.gov.uk/highways

Suffolk Highways
your roads, our business
follow us @suff_highways
report a fault highwaysreporting.suffolk.gov.uk
what's happening in my area? https://one.network

From: Andy Pearce <[redacted]
Sent: 27 March 2020 09:15
To: Amanda Mays <Amanda.Mays@suffolkhighways.org>
Cc: Stuart Heald (SCC) [redacted]
Subject: FW: AIL Access to Bramford Substation

Good Morning Amanda,

Further to my emails with Stuart below can you confirm whether the proposed heavy loads would be permitted to cross the small culvert 493 S of White Elm Copdk? I attach the potential loads for information.

It would of course be easiest if we can continue to cross without any specific restriction. However, if you are unable to confirm this, Stuarts suggestion of a pre and post movement condition survey would seem reasonable to me.

Please note that at present this is the least preferred route and would only be used if the others cannot be made to work for any reason.

Thank you in advance for your assistance.

Kind Regards

Andy Pearce
General Manager (IOSH)
[redacted]

Shaftesbury House, High Street, Eccleshall, Staffordshire ST21 6BZ, UK
[redacted]
wynnslimited.com
Registered in England & Wales No. 3162297

I will be working from home until further notice so call my mobile in the first instance:
[redacted]

From: Stuart Heald (SCC) <[redacted]
Sent: 26 March 2020 18:29
To: Andy Pearce [redacted]
Cc: Amanda Mays [redacted]
Subject: RE: AIL Access to Bramford Substation

Andy,

The sort answer is that I do not know since it is not an asset that I manage. As you can see from the attached photo's, the culvert comprises twin RC pipes less than 900mm in diameter and as such will not be classed as a highway structure covered by DMRB. I would suggest you agree a dynamic risk assessment with Amanda (as the asset owner), to ensure they are not damaged by your proposed movement. As this forms part of the historic DfT HR82 route, I would suggest a photographic survey before and after the movement may be sufficient?

Stuart Heald BEng (Hons) CEng MCIHT
Structures Condition and Assessment Manager

Suffolk Highways I Desk 39 (Block 1GF), Phoenix House, 3 Goddard Road, IPSWICH, Suffolk, IP1 5NP
M[redacted] I www.suffolk.gov.uk/highways

Suffolk Highways
your roads, our business
follow us @suff_highways
report a fault highwaysreporting.suffolk.gov.uk
what's happening in my area? https://roadworks.org

From: Andy Pearce [redacted]
Sent: 26 March 2020 16:00
To: Stuart Heald (SCC) [redacted]
Subject: RE: AIL Access to Bramford Substation

Hello Stuart,

Thanks for the email and information which is useful in explaining the current status of each of the structures. Can you just clarify one thing please in respect to 493 S of White Elm Copdk. Does the fact it is not subject to a quantitative design or assessment capacity mean it is considered to be OK or would we also need to do a specific load assessment for this?

Kind Regards

Andy

From: Stuart Heald (SCC) [redacted]
Sent: 25 March 2020 20:54
To: Andy Pearce <[redacted]
Cc: Hyde, Nicolas [redacted]; David Chenery [redacted]
Steve Merry [redacted]; Chris Graves [redacted]
Subject: RE: AIL Access to Bramford Substation

Hi Andy,

Things are a little hectic hear, so sorry for not getting back to you sooner. I've copied Nick into this e-mail, so he knows were we stand as far as local highway structures are concerned for the routes from Ipswich to Bramford, noted below. Unfortunately I can not comment on your routes in respect to Suffolk County Council and Suffolk Highways generally, hence why I've copied others into this e-mail.

In respect to options 1 & 2 and your refer to structure 710 Raw Water Main Culvert, following it's latest structural review in 2019, attached, this structure is currently restricted to STGO 3 vehicles pending further investigations and an assessment as recommended. Either these investigations and assessment can be undertaken by your client to our specifications and technical approval or an alternative approved load distribution method implemented.

As you have noted in option 2 the current structural capacity of 1007 Ostrich Creek Bridge is restricted to SV80 (30 HB). Again either further detailed assessment and strengthening could be proposed or an alternative approved load distribution method implemented.

Option 3 utilises the historic DfT HR82 Route and you are correct that structures 388 Washbrook Flood Culvert and 709 Washbrook Bridge are both on this route. However both structures are currently restricted to STGO 3 vehicles pending further assessment as noted in the attached 2019 reviews. 493 S of White Elm Copdk is a small span drainage asset, so is not subject to a quantitative design or assessment capacity.

I hope the above clarifies our position further, but as always please ask if you require further information.

Stuart Heald BEng (Hons) CEng MCIHT
Structures Condition and Assessment Manager

Suffolk Highways I Desk 39 (Block 1GF), Phoenix House, 3 Goddard Road, IPSWICH, Suffolk, IP1 5NP
M: [redacted] I www.suffolk.gov.uk/highways

From: Andy Pearce [redacted]
Sent: 24 March 2020 09:21
To: Stuart Heald (SCC) [redacted]
Subject: FW: AIL Access to Bramford Substation

Hello Stuart,

I trust that you are keeping well and spirits up at this most strange time. I just wanted to check you were OK with our summary of our understanding of SCC's position reference the route to Bramford as below. We have a conference call with HE East Area and the AIL Team on 2nd April and it would be good to confirm prior to that if possible.

Stay safe!

Regards

Andy Pearce

From: Andy Pearce
Sent: 27 February 2020 16:23
To: Stuart Heald (SCC) <[redacted]
Cc: Daisy Gosling [redacted]; Highways Safety and Speed Management <SafetyandSpeedManagement@suffolkhighways.org>
Subject: AIL Access to Bramford Substation

Dear Stuart,

It was nice to see you again last week at your offices in Ipswich. We thought that it would be useful to write to you to seek confirmation of our understanding in respect to the potential routes to Bramford Substation. As we outlined, National Grid are aiming to deliver a transformer of 178te nett weight in 2021. For reference I attach trailer arrangements from Allelys, Colletts and ALE (now Mammoet) that could be considered for the actual delivery. There are a couple of options to consider as detailed below. As we have already discussed Highways England's Abnormal Loads Team have issued an Agreement in Principle, directing National Grid to deliver the transformer via Ipswich in line with the Department for Transports Water Preferred Policy and so they need to progress with securing a route on this basis.

Option 1 ABP Ipswich Cliff Quay East of the river (Preferred) - Transformer is delivered to Ipswich Docks Cliff Quay and routes out via Landseer Road/Nacton Road to the A14, then west to A1214, A1071 and B1113.

- Load joins A14 east to A12 roundabout before returning A14 west over Orwell Bridge.
- There are no Suffolk County Council structures of concern on the section from the port to A14.
- Removal of street furniture items will need to be arranged prior to delivery. We can send details of the items we think will need to be removed if you think it useful but there is probably no need for this at this stage.
- Clarification from Highways England East is required for it to cross Orwell Bridge but based on other recent movements we would hope that this is achievable. If not Option 2 will apply.
- Clarification from Highways England East is required to confirm if the bridge carrying the A14/A12 to the A1214 to provide access to A1214. If this cannot be secured that contingency Option 3 would need to be investigated but is not preferred.
- If Option 3 is not feasible then discussions with Highways England East would be needed to see if crossover of A14 prior to the A14/A12/A1214 could be undertaken.
- There is a culvert on the A1214 that a recent inspection by Suffolk County Council has identified would now need a structures review to be carried out prior to AIL access being permitted (Raw Water Main Culvert – ID 710). This would need to be carried out by a third party consulting

engineer. The structure is understood to be deeper on the eastbound A1214 so contraflow from A14 to A1071 would not help. Suffolk County Council would require payment for the time required to source all available bridge records for inclusion in any future assessments and structures review.

- No other Suffolk County Council structures on A1071, B1113 and Bullen Lane.
- B1113 Sproughton – Parking restrictions would be needed to remove parked cars. TTRO required.
- TTRO needed to legally overcome the 7.5te environmental weight limit on B1113.
- Left turn into Bullen Lane. We consider that this would be best access for girder frame trailers by driving past and reversing. It would appear from new fencing here that this was undertaken for 2019 deliveries.

Option 2 ABP Western Terminal - Transformer is delivered to Ipswich Docks and routes via A137 to A14 junction.

- This would only be considered in the event that Highways England East refuse the load permission to use A14 Orwell Bridge on Option 1.
- Expected that it will be necessary to travel on A14 eastbound in contraflow from A137 to A14/A1214 interchange to avoid A137 junction bridge.
- It is recognised that this will present issues with obtaining clearance over the Suffolk County Council structure on the A137 at Ostrich Creek. This was recently accessed with loads in excess of 200te by Allelys for the offshore windfarm onshore Substation located immediately adjacent to National Grid Bramford Substation but only after assessments and with a detailed rafting scheme for the heaviest loads. Initially it would be necessary for a third party consulting engineer to carry out an assessment to confirm whether the lighter transformer loads can pass or if similar temporary bridging is again needed.
- You asked me for an indication of cost for such works. A very high level estimate for the mobilisation and installation of the bridging units with mobile cranes would be in the region of £90k for installation, traffic management, removal of street furniture, TTRO etc. All subject to agreement of exact methodology with Suffolk County Council as highway authority.
- Suffolk County Council would require payment for the time required to source all available bridge records for inclusion in any future assessments and design of bridging schemes. We will report to our client that a similar exercise would be required in the future
- A shunt is required at the A14/A1214 interchange to get from the A14 east entry slip road in contraflow to the A1214 correct direction.
- Route then joins Option 1 above for final approach to site.

Option 3 Old Route via Copdock/London Road/Swan Hill.

- This would only be considered in the event that those above are unsuitable for any reason.
- The alignment of access from A12 westbound to London Road at White House is poor and remedial works would be needed to enable access physically.
- Suffolk County Council has 2 structures that would need a structures review to be carried out prior to AIL access being permitted. We assume from ESDAL that these are Washbrook Bridge and Washbrook Flood Culvert? The assessments would need to be carried out by a third party consulting engineer.
- Suffolk County Council would require payment for the time required to source all available bridge records for inclusion in any future assessments and structures review.
- There seems to be another structure on ESDAL shown as “S of White Elem Copdock”. Would this also need a structures review?
- Negotiability of Chapel Lane and Swan Hill would need to be considered in more detail for girder frame trailers.

I trust that this above is a fair summary of the situation and look forward to your clarification in order that we can report to National Grid accordingly but if you wish to discuss anything further please do not hesitate to contact me.

Kind Regards

RECORD OF STRUCTURAL REVIEW TO BD101

1	**STRUCTURE DETAILS**	
1.1	Structure Name	*Raw Water Main Culvert*
	Structure No.	*75/45*
	Structure Code.	*710*
1.2	Date Commissioned	*1984* *(maintenance manual states opened to Traffic on 18th July 1984)*
1.3	Obstacles crossed	*1m Diameter water main*
	Structure carries	*A1214 Dual Carriageway*
1.4	Structure type, form, span, skew, carriageway & verge widths	*- Structure Type: Culvert with inspection chambers at each end* *- Form: Single span circular corrugated steel ARMCO pipe, 4.2mm thick multi-plate pipe, 3.52m DIA. Reinforced concrete inspection chambers are provided at each end. Removable precast concrete cover slabs supported on steel I-beams are provided at the chamber at the northwest end.* *- Length of culvert: approx. 45.1m* *- Culvert Diameter: 3.52m* *- Skew (º): N/A. Carriageway crosses structure at approx. 45°* *- Carriageway width (m): approx. 21m for dual 2 lane carriageway based on central reserve of 2.5m, 7.3m carriageways with two 1m hard strips to both carriageways.* *- Verge widths (m): Approx. minimum of 2m*
1.5	Reason for Structural Review	*Routine Principal Inspection (PI)*
2	**EXISTING ASSESSMENT DETAIL OR DESIGN RECORDS**	
2.1	Design capacity	*The available design AIP signed and dated 1981 and the Maintenance Manual for the structure dated 1984 indicate that the structure was designed for:* *- HA+45 units HB loading* *- Abnormal loading of 260T gross on trailer no. 999/1277* *Only the steel pipe culvert runs under the carriageway. The inspection chambers are located below the verges of the carriageway. It is therefore ambiguous whether the chambers have been designed for the above traffic loading. Accidental Wheel Loading (AWL) is included in the BE 1/77, part of the signed AIP Technical Approval Schedule (TAS), indicating that the structure including the north west chamber should have been designed to withstand a form of AWL.* *Vehicle Rating using BD 86/11 Annex C HB to SV Conversion Charts is not deemed applicable to this type of structure (BD 86/11 Annex C4.3).*
2.2	Date of Assessment	*N/A*
2.3	Assessment report reference	*No Assessment Reports have been provided to AECOM for this structural review.*
2.4	Certification	*No certificates have been provided to AECOM for this structural review.*

2.5	Calculations	*No calculations have been provided to AECOM for this structural review.*
2.6	As built drawings	*Extracts from drawings as part of a Roads 277 form including plan, cross section and long section have been provided to AECOM for this structural review.* *Full drawings as listed in the AiP and maintenance manual have not been provided to AECOM for this structural review.*
2.7	Critical elements	*N/A since no design or assessment data have been provided to AECOM for this structural review.*
2.8	Comments on Assessment or Design	*N/A since no design or assessment data have been provided to AECOM for this structural review.*
3	**EVALUATION**	
3.1	Inspection Date	*PI dated 13th September 2017*
3.2	Change in Condition	*a) Corrugated steel ARMCO pipe culvert* *In the 2017 PI the steel culvert was reported in good condition with no signs of deformation or displacement and no significant deteriorations from the previous 2012 PI. However reference is made in the report to the possibility of expansive corrosion in the corrugated steel as the ultrasonic steel thickness measurements taken during the report were unable to confirm the 4.2mm steel thickness stated in the available Maintenance Manual. There was also an area of surface corrosion in the culvert which was given a severity rating of 3 "Moderate defect damage some loss of functionality could be expected".* *For assessment purposes, a condition factor of 1.0 can be used subject to the assessment being based on the actual steel thickness measured prior to the assessment to confirm if expansive corrosion has occurred.* *b) Inspection chambers at each end of culvert* *Significant section loss was noted in the 2017 PI to the steel I-beams supporting the precast concrete slabs of the north chamber. It is expected that this defect would reduce the capacity of this part of the structure from that of the design loading. No other significant defect was noted to the chambers that would reduce their capacity from that of the design loading.* *For assessment purposes a condition factor of 1.0 can be used for the end chambers subject to the assessment being based on the actual steel thickness of the I-beams measured prior to the assessment to take into account the section loss noted.*
3.3	Change in Standard	*Design predates the DTp design standard BD12/82 – Design of Corrugated Steel Buried Structures.* *Based on the ARMCO published design manual prior to BD 12, the principle of design is based on the Ring Compression Theory, where the structure is considered as flexible steel rings in compression [The Design AIP states that method of analysis for the pipe culvert will be the Ring compression method in accordance with the manufacturer's recommendations].* *Prior to 1982 standard U.K. practice was to undertake design using procedures developed by American Iron and Steel Institute (AISI) with modifications to suit national loading requirements.* *It was common practice for structures installed prior to 1982 not to have been designed with any sacrificial steel thickness, and the structure may therefore not comply with current durability rules.* *[BD 12/01 requires such structures designed today to be provided*

		with sacrificial thickness to achieve a 120 year design life taking account of the corrosivity of the environment and the galvanising and any other coatings provided.] *Conclusion – There has been a change in the design standard for the structure since it was built.*
3.4	Change in Loading	*None Assumed.* *SCC has not advised of any change to the operational load carrying requirements for the structure.*
3.5	Recommendation	*a) Corrugated steel ARMCO pipe culvert* *A recommendation for structural assessment cannot be given at the moment as there is uncertainty on the condition of the steel pipe. Undertake a Special Inspection to confirm the thickness and condition of the corrugated steel. Investigatory small diameter core drilling to be undertaken if an ultrasound survey cannot give consistent steel thickness measurements. BD101 review to be revisited following the Special Inspection.* *b) Inspection chambers at each end of culvert* *Undertake assessment to confirm loading capacity of the steel I-beams and the precast concrete cover slabs at the NW inspection chamber. This is recommended as the steel I-beams are corroded and it is not known whether the inspection chamber cover was designed for accidental loading to which it could be subjected due to its location in the verge.* *c) General recommendation* *As no design certification is available for the structure the overseeing organisation should consider an assessment if a signed assessment certificate is required. A new assessment could also confirm the SV rating of the structure.*
4	**ASSESSMENT JUSTIFICATION (delete or complete as applicable)**	
4.1	Proposed assessment method	*-BA87/04 Management of Corrugated Steel Buried Structures* *-BD44/15 The Assessment of Concrete Highway Bridges and Structures* *-BD56/10 The Assessment of Steel Highway Bridges and Structures* *-BD61/10 The Assessment of Composite Highway Bridges and Structures*
4.2	Proposed approach to establish current condition	*Principal Inspection dated 11th October 2017.*
4.3	Basis of structural / material properties for assessment	*BA87/04 (Cl. D10) minimum yield strength for corrugated Steel = 230N/mm²* *BD21/01 (Cl. 4.3) minimum yield strength for structural Steel = 230N/mm² or as confirmed by sample testing.* *Concrete Class 30/20 taken from AiP*
4.4	Proposed testing and site investigation	- *Special Inspection to confirm the thickness and condition of the corrugated steel. Investigatory small diameter core drilling to be undertaken if an ultrasound survey cannot give consistent steel thickness measurements.* - *Steel thickness measurements to the northwest chamber steel I-beams.* - *Ferroscan of precast concrete cover slabs to ascertain reinforcement bar size, cover and spacing.*

4.5	Proposed checking category	*Category 0 (not requiring an AIP) for the steel I-beams and concrete cover slab of access chamber*	
5	**<u>Endorsement</u>**		
		Proposed by	*Apostolos Kougiamis* *MSc DIC CEng MICE* *Principal Engineer*
		Signed	[redacted]
		Date	*2018-04-04*
5.1	TAA Conclusion	*Having considered the records available for this structure and any changes in condition, standards or loading, I'm not satisfied that the current structural capacity of this structure is adequately known. While this CSBC is of a significant span and carries an A class road which is regular used for AIL movements, its cover of 1.7m is significant. Therefore, due to its current condition I do not consider this to be a low risk provisionally substandard structure to BD79/13. However, since this route has recently been used by a Special-Order vehicle, I would agree that its structural capacity should be confirmed following guidance within DMRB (BA55/06), with a proposed checking category of CAT 1, however it should be noted that the concerns noted in CS 460 are not present. Furthermore, considering the evidence contained in this review I'm satisfied that the CSBC remains safe for use so long as a Special Inspection possibly followed by an assessment is undertaken within the next 24 months.*	
		Agreed by	*Stuart Heald BEng CEng MCIHT* *Structures Asset Manager*
		Signed	[redacted]
		Date	*08/02/2019*

Appendix 5

Suffolk Police AIL Guidance Document

POLICY

Abnormal Loads Policy

Owning Department:	Protective Services		
Department SPOC:	Abnormal Loads Officer		
Risk Rating:	Low	Legal Sign Off: Date:22.2.21	Alison Ings

Approved by

JNCC:	December 2016		
Published Date:	14/08/2020	Review Date:	14/08/2024

Index

Legal Basis

Legislation/Law specific to the subject of this policy document

Act (title and year)
The Road Vehicles (Construction and Use) Regulations 1986
The Road Vehicles (Authorisation of Special Types) (General) Order 2003
The Road Traffic Act 1960 1988 1991 as amended
The Road Vehicle Lighting Regulations 1989
Regulation 25 of the Road Vehicles Lighting Regulations 1989

Other legislation/law which you must check this document against (required by law)

Act (title and year)
Human Rights Act 1998 (in particular A.14 – Prohibition of discrimination)
Equality Act 2010

Crime and Disorder Act 1998
Health and Safety at Work etc. Act 1974 and associated Regulations
General Data Protection Regulation (GDPR) and Data Protection Act 2018
Freedom Of Information Act 2000
The Civil Contingencies Act 2004

Other Related Documents

- Highways England Abnormal Loads Form and Guidance – July 2012
- Highways Agency Code Of Practice For Self-Escorting Of Abnormal Loads (Department of Transport)
- All Forms can be obtained from the Abnormal Loads Officer in the Roads Armed Policing Team (RAPT).

1. Summary Aim of Policy

1.1 To outline the considerations for policing the safe progress of Abnormal Loads throughout the areas of Norfolk and Suffolk Constabularies.

2. Benefit of Policy

2.1 To provide clarity regarding the responsibilities of the Constabularies in relation to the escorting of Abnormal Loads and the associated procedures.

3. Reason for the Policy

3.1 Norfolk and Suffolk Constabularies recognise their duty under Article 2 of the Human Rights Act 1998 to protect life and the need for safe and efficient transport of Abnormal Loads, including Abnormal Indivisible Loads, on roads within the areas of Norfolk and Suffolk Constabularies.

Purpose

3.2 This policy provides a framework for the management and administration of Norfolk and Suffolk Constabularies responses to escorting Abnormal Loads, including Abnormal Indivisible Loads, within the areas of the Constabularies, and to meet the requirements of legislation and regulations governing their movement. The policy also sets out the standards for the provision of Police Escort service.

4. Description of the Policy

4.1 The responsibility for the safe management of Abnormal Loads lies with the haulier and driver, and is regulated by law. The role of Norfolk and Suffolk Constabularies in respect of most Abnormal Loads is therefore to ensure compliance with the law.

4.2 In accordance with an agreement by the haulage industry, the Highways Agency and National Police Chiefs' Council (NPCC), routine escorting of Abnormal Loads authorised by The Road Vehicles (Authorisation of Special

Types) (General) Order 2003 (STGO) will not be carried out by Norfolk and Suffolk Constabularies but in most cases by the hauliers themselves. Norfolk and Suffolk Constabularies will not escort Abnormal Loads which are up to 5.0 metres wide, except where no alternative arrangement can adequately ensure public safety.

5. What is an Abnormal Load?

5.1 An Abnormal Load is a load which exceeds the following weight and/or dimensions:

- 2.9 metres (9ft 51in) wide;
- 305mm (1ft) lateral projection;
- 44 tonnes in weight;
- 18.65 metres (61ft 2in) load length;
- 25.9 metres (85ft) overall length;
- 3.05 metres (10 ft) front or rear projection;

(The Road Vehicles (Construction and Use) Regulations 1986).

5.2 An Abnormal Indivisible Load is an Abnormal Load that cannot without undue expense or risk of damage be divided into two or more loads for the purpose of being carried on a road (The Road Vehicles (Construction and Use) Regulations 1986).

6. Legislation Covering the Movement of Abnormal Loads

6.1 The movement of Abnormal Loads on the road is covered by STGO, The Road Vehicles (Authorised Weight) Regulations 1998 and regulations 81-82 of The Road Vehicles (Construction and Use) Regulations 1986.

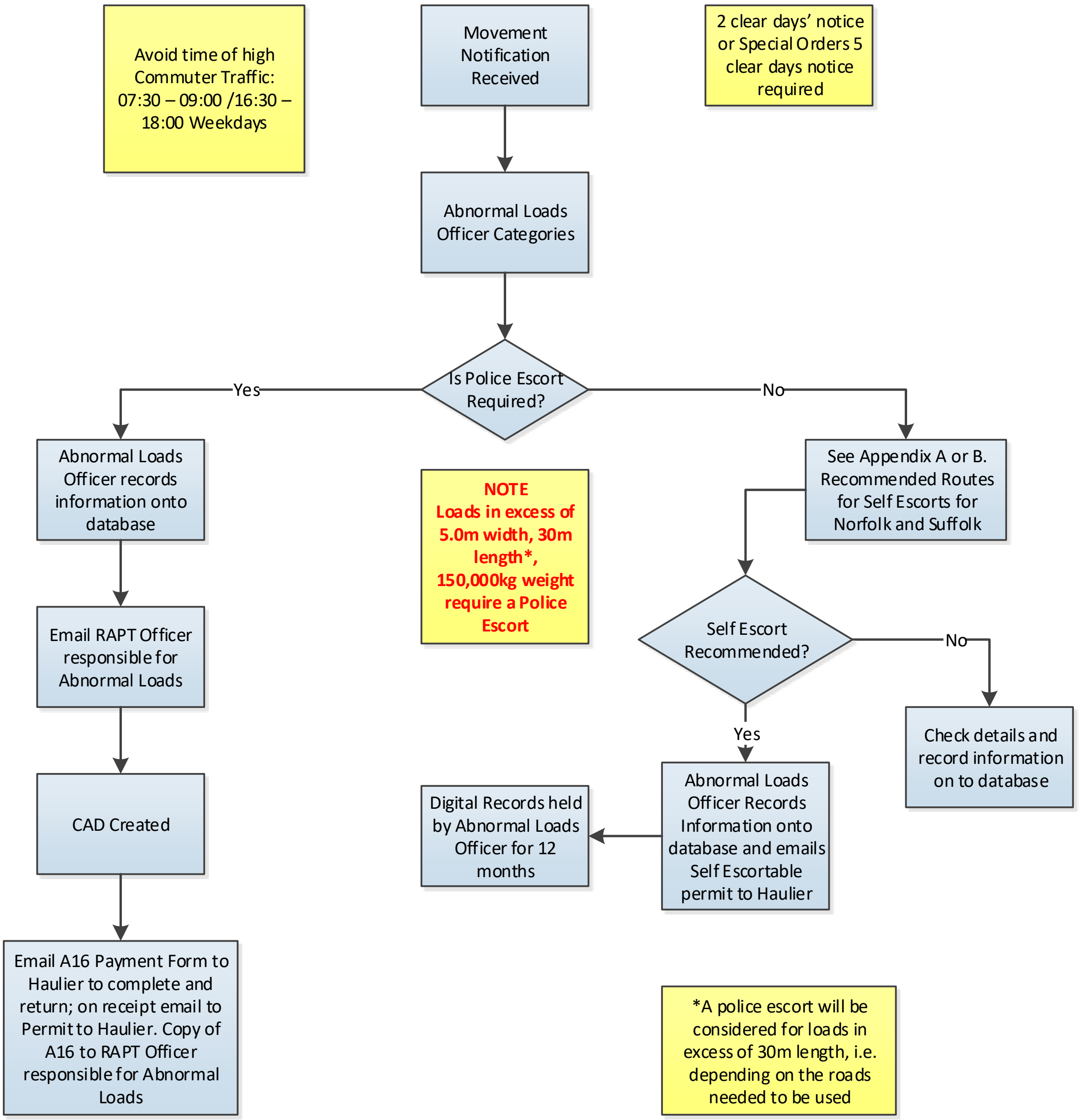
6.2 Norfolk and Suffolk Constabularies recognise the importance (to the economies of the counties) of the ability of the haulage industry to safely, successfully and efficiently transport Abnormal Indivisible Loads on the highways network of Norfolk and Suffolk Constabularies areas. Legislation does not contain any requirement for any Abnormal Indivisible Load to be escorted (Police escorts are requested and charged at SPS rates). Legally enforceable standards exist for the notification of Abnormal Indivisible Load movement to both the Chief Constables and the Road and Bridge Authorities.

6.3 Norfolk and Suffolk Constabularies are not responsible for ensuring the safe operational passage of Abnormal Indivisible Loads on the roads of Norfolk and Suffolk. Unless the Abnormal Indivisible Load is being escorted by the police, this is the role of the Haulier.

6.4 All employees of Norfolk and Suffolk Constabularies should be cognisant of their primary responsibility to preserve life and for public safety.

7. Flowchart 1: Abnormal Loads Process

7.1 Abnormal Loads will not be moved during the hours of darkness (which means the time between half hour after sunset and half an hour before sunrise, as defined by the Road Vehicles Lighting Regulations 1989) in Norfolk or Suffolk without express permission of the Abnormal Loads Officer.



8. Legislation

<u>The Road Vehicles (Authorisation of Special Types) (General) Order 2003 (STGO)</u>

8.1 This Order is a general order made under section 44(1) of the 1988 Road Traffic Act. It authorises road use by certain special types of vehicles, notwithstanding that they do not fully comply with regulations made under section 41 of the 1988 Road Traffic Act. It imposes the restrictions and conditions with which such vehicles must comply, including the extent to which regulations made under section 41 must be observed. Abnormal Indivisible Load vehicles are one of the specific vehicles authorised on permitted road use subject to STGO Regulations. Such vehicles may only be used for the carriage and movement of Abnormal Indivisible Loads.

Highways England Form VR1 (Permit)

8.2 This is required for vehicles / loads with widths exceeding 5.0 metres (16.402” ft) up to 6.1 metres (20.013” ft). The form is completed by the haulier and they only need to supply Norfolk and Suffolk Constabularies with the reference number of the VR1 related to that particular vehicle/load, this can only be done electronically by Electronic Service Delivery for Abnormal Loads (ESDAL) or email.

ESDAL website: https://www.gov.uk/register-with-esdal

Abnormal Indivisible Load movements

8.3 The legislation that permits Abnormal Indivisible Load movements is:

- Road Vehicles Construction and Use Regulations 1986 (C&U)
- Road Vehicles Authorisation of Special Types (General) Order 2003 (STGO)

8.4 C&U Regulations requires hauliers to notify the movement of all Abnormal Indivisible Loads and Abnormal Indivisible vehicles to the Police before moving them by road.

8.5 C&U Regulations is the primary legislation for the construction and maximum dimensions for all vehicles, and is the only legislation that can be used for prosecution purposes.

8.6 STGO permits the use of vehicles and / or loads which cannot comply with the maximum permitted weight, either gross or axle weight, for the class of vehicle being used for transporting a load.

8.7 STGO also contains the regulations for loads that exceed the maximum width permitted by C&U Regulations, agricultural vehicles and many other miscellaneous vehicles.

8.8 The legislation is in the most part permissive, in that providing that the haulier complies with the requirements of notification procedures, an Abnormal Indivisible Load can be moved without the need for any permit or authorisation.

8.9 The only exceptions are as follows:

- Loads exceeding 5.0 metres (16.402” ft) wide which require a VR1 Permit from Highways England, which authorises the movement, but not the route, time or date this has to be arranged with the Police Authority in that particular force area. Once the VR1 has been issued the haulier can then use the normal notification procedure, quoting the VR1 reference.

- Loads exceeding 6.1 metres (20.013” ft) wide, 30 metres (98.42”ft) rigid length or 150,000 kilogram’s (147.63 Tonnes) weight, which require a Special Order from the Secretary of State. A Special Order ensures that the route is negotiable and may lay down certain conditions. It does not, however, replace the notification procedure.

9. Escort Policy

9.1 Norfolk and Suffolk Constabularies will comply with the NPCC recommendation to withdraw from the routine escorting of Abnormal Indivisible Loads.

9.2 The practice of Police Escorting Abnormal Indivisible Loads is a self-imposed duty, established many years ago and initially undertaken for purposes of road safety and to minimise congestion.

9.3 Legislation does not contain any requirement for any Abnormal Indivisible Load to be escorted by the Police.

9.4 The escort criteria adopted by Norfolk and Suffolk Constabularies have been progressively adjusted over time, based on the National Police Chiefs’ Council (NPCC) guidelines

9.5 Norfolk and Suffolk Constabularies require a **minimum** of **2** clear days’ notice for each request for movement. It is the responsibility of the Abnormal Loads Officer to define what type of category the Abnormal Indivisible Load is.

9.6 Any long or short term projects which will increase abnormal loads on the network will be reviewed in accordance with the policy, but the requirement for police or private self-escort provision will be assessed on a project specific basis, to ensure public safety.

<u>Police Escort</u>

9.7 The Norfolk and Suffolk Constabularies Abnormal Loads Officer will carry out a risk assessment of each proposed Abnormal Indivisible Load and a charge will be made for the provision of a Police Escort service.

9.8 It is the responsibility of the Abnormal Loads Officer to determine whether the Norfolk or Suffolk Constabularies will or will not escort an Abnormal Load and will liaise directly with the RAPT Officer responsible for Abnormal Loads regarding individual escorts. Where appropriate it may be necessary to contact RAPT to arrange a suitable Police resource to assist with the safe movement of a load.

9.9 In the event of a load being notified where there may be a public interest; the Abnormal Loads Officer will liaise with the Media Office and all Police Escort will be appear on Norfolk and/or Suffolk Constabulary Webpages.

9.10 In general, no movements are to take place during the hours of darkness (defined above at 7.1), or on Bank Holidays. Movements may not take place during peak holiday or event period(s).

9.11 The Police Escort Process which the haulier has to go through is:

- The haulier must submit a Notification Form, this will then be logged on the Norfolk and Suffolk Constabularies Abnormal load database. The Notification form is the only accepted method of request unless by prior agreement by the Abnormal Loads Officer.
- An A16 Application Form will then be sent to the haulier for them to complete and send back with the relevant information on it.
- A Police Escortable Load Permit, if granted by the Abnormal Loads Officer will then be sent to the haulier to grant them permission to move this vehicle/load(s) on the agreed time, date and route.
- If not approved it is the responsibility of the Abnormal Loads officer to contact the haulier and explain why it has not been approved.
- If approved, the forms will then be sent by the Abnormal Loads Officer to the relevant Police personnel carrying out the escort or anyone else requiring them. The Officer Advice will then be sent to the Police personnel assigned to the movement.

<u>Self-Escort (by, or on behalf of the Haulier)</u>

9.12 Where a load falls below the Special Order criteria, as set out below at paragraph 10:

9.13 The Highways Agency Code of Practice sets guidance for self-escort. As the main purpose is that of safety, if the Abnormal Load Officer or other suitable trained representative of Norfolk and Suffolk Constabularies deem that a self-escort is required, it will then be the requirement of the haulier/company to provide the required level of escort.

9.14 The Self-Escort Process which the haulier has to go through is;

- The haulier must submit a Notification Form, this will be then logged on the Abnormal Load database by the Abnormal Loads Officer.
- Published by Norfolk and Suffolk Constabularies is a list of all key arterial routes and classifications as undertaken by the Constabularies through the County of Norfolk and Suffolk (Appendix A and B). If the dimensions of the vehicle/load exceed the measurements (Appendix A and B) then a “Self-escort” will be required.
- A Self-Escortable Abnormal Load Permit will then be sent to the haulier by the Abnormal Loads Officer if all items are agreed by the Abnormal Loads Officer. If not approved it is the responsibility of the Abnormal Loads Officer to advise the person/company requesting why this is not acceptable.

Non-Escorted Loads

9.15 Where a load falls below the Highways Authority Code of Practice criteria for self-escort, and there are no other safety considerations, then a self-escort will not be required; although the haulier may still provide one.

9.16 Where the Constabularies are required to assist an Abnormal Indivisible Load in order for it to negotiate a contradiction of a road traffic sign, such assistance will not be charged for and will be carried out by suitable trained staff during their normal tour of duty. However, once the assistance has been rendered, the officers should normally end their involvement and return to their policing duties.

9.17 Where the haulier provides their own self / private escort, they are expected to comply with any instructions issued by either Norfolk or Suffolk Constabularies, and to comply with the Highways Agency Codes of practice.

9.18 Where a haulier fails to comply with Constabularies instructions and restrictions or the Highways Agency Code of Practice, offences may be committed in contravention of C&U and STGO Regulations. Additionally, any incidents that occur will be examined in respect of Road Traffic legislation and criminal law.

9.19 Where a Police Escort is provided or assistance is required, upon request by the haulier, it will be conducted by suitable trained officers from the RAPT. These Officers must ensure that the vehicle is roadworthy, and will check all relevant documentation and compatibility with the load to be escorted. RAPT to assist in directing a load at a given point or this may be conducted by other Norfolk or Suffolk Constabularies employees.

9.20 Where a Police Escort is provided, the Constabularies services will recover costs from the haulier on a strictly non-profit basis as follows:

- Normal practice will be that Police Officers from the RAPT, performing overtime on their rest days will be utilised.
- A minimum of five days-notice will be required for the arrangement of a Police Escort.
- Charges to be paid in full in the event of any cancellation or amendment to the movement date, within five working days of the agreed move date.
- Amounts payable due within 14 days of receipt of invoice.

9.21 The Non Escortable Process which the haulier has to go through is;

- To submit a Notification Form, this will be then logged by the Abnormal Loads Officer.
- If the dimensions of the vehicle/load(s) do not exceed the requirements for the route/roads in which they wish to travel along in relation to the Route Classification (Appendix A and B), which has been advised by the Abnormal Loads Officer, a 'Self-Escort' will then not be required.

10. The Highways Agency Code of Practice Criteria

10.1 The Highways Agency Code of Practice criteria for self-escort (excluding motorways) are:

Measurements	Dimensions
Load / Vehicle Width Exceeds	4.1 M 13'6" Feet
Overall Vehicle Length Exceeds	30.5 M 100,00" Feet
Overall Vehicle/Load height Exceeds	4.87 M 16,00" Feet
Vehicle Gross Weight Exceeds	100 Tonnes

11. Restrictions

11.1 Once an Abnormal Indivisible Load movement has been notified to Norfolk or Suffolk Constabularies, restrictions may be placed on the movement. These restrictions normally govern roads, times and/or days that a load is permitted to move. This normally prevents an Abnormal Indivisible Load from travelling during:

- The hours of darkness with the exception of the A12 Essex border to A14 Copdock Interchange and A14 Felixstowe to Cambridgeshire border with width, weight and length restrictions.
- Bank holiday weekends
- During periods where a major event has been planned
- At certain times of days such as "rush hours" high commuter traffic between 07:30 – 09:00 and 16:30 -18:00
- Other times at the discretion of the Abnormal Loads Officer

11.2 Any deviation from the restrictions above can only be given by the Abnormal Loads Officer, having given due consideration to road safety and congestion issues, except in the hours of darkness where authority for any deviation can only be given by either the Contact and Control Room Duty Inspector and or in conjunction with the Duty RAPT Inspector / Sergeant.

11.3 The Abnormal Loads Officer should give due consideration to the Local Highways Authorities' Street-work(s) Register's when approving any Abnormal Indivisible Load movement.

11.4 Where a Police Escort is appropriate, the driver of the Abnormal Indivisible Load, his / her attendants and any self / private escort provided will at all times comply with any instructions issued by Norfolk or Suffolk Constabularies, in relation to escorting Abnormal Indivisible Loads.

11.5 The permitting of self / private escorting of Abnormal Indivisible Loads will not remove the requirement of the driver and his / her attendants to comply with the Road Traffic Act or any associated legislation regarding the use of any motor vehicle on a road.

11.6 In the event of any dispute with a haulier over the movement of an Abnormal Indivisible Load, whether escorted or otherwise, a decision will be made by the Abnormal Loads Officer in consultation with the Senior Traffic Officer available. A record should be made of the decision and rationale and will be retained by the Abnormal Loads Officer for a period of one year.

Please Note: *Always refer to the Highways Agency to ensure Policy is up to date.*

12. Administration

12.1 All notifications and enquiries relating to Abnormal Indivisible Loads will be dealt with by the Abnormal Loads Officer.

12.2 On receipt of a notification a reference number will be generated from the Abnormal Loads Database. This will be emailed to Haulier on the Self Escort Permit, or if no Self Escort Permit is issued, retained on the Abnormal Load Database. The original correspondence will be stored digitally and kept for a period of 1 year.

12.3 In the event of a haulier sending notification direct to a Police Station or another Office, the person(s) receiving this correspondence shall immediately contact the Abnormal Loads Officer and arrange forwarding on of the information/request in an appropriate manner.

13. Designated / Undesignated Routes

13.1 Whilst the majority of Abnormal Loads travel along designated routes, if the load is to travel on minor or infrequently used roads, it is the responsibility of the haulier to ensure the route is negotiable and suitable for the vehicle and load. This applies to escorted and non-escorted loads and is carried out in cooperation with the Abnormal Loads Officer.

13.2 The haulier, the Abnormal Loads Officer and / or a Police Escort Officer will check any undesignated route to confirm the suitability for the load(s) notified.

13.3 It is the responsibility of the haulier to check whether any roadworks or road closures, or events that are current or planned, may cause the route to be altered or unsuitable.

14. Abnormal Loads Dispensation

14.1 An Abnormal Loads Dispensation is a document that is issued on an annual basis. This allows hauliers to transport Abnormal Loads only if they meet the required specifications for the 2 particular uses. There are 2 different types of Abnormal Load dispensation which are:

<u>General Dispensations</u>

14.2 General Dispensations Form can be authorised and issued by the Abnormal Loads Officer on the behalf of the Chief Constable, to hauliers / operators who frequently move notifiable Abnormal Loads up to a maximum width of 3.5metres (11.45” ft).

14.3 This allows movement of specific loads without the requirement to notify Norfolk and/or Suffolk Constabulary 2 clear days in advance. The dispensation relates only to the vehicles operated by the named company.

14.4 No movement under the dispensation shall take place during in the hours of darkness.

14.5 Each load so authorised must have a copy of the dispensation in the driver’s possession and must be valid from 1st January to 31st December depending on when they apply or part year thereof from date of issue.

14.6 Back dating of certificates is not permitted in any circumstance.

14.7 These dispensations are granted pursuant to paragraphs 2(4) and 4(2) of schedule 5 to the STGO Regulations which gives discretion to the Abnormal Loads Officer to accept shorter notice periods and fewer details than those otherwise required by schedule 5.

Agricultural Dispensations

14.8 Agricultural Dispensations Form can be authorised and issued by the Abnormal Loads Officer on the behalf of the Chief Constables, to farmers, farm companies and farming contractors, who can demonstrate the need to move agricultural vehicles, implements and appliances on public roads in the course of their business. This is subject to the agreement of the Norfolk and Suffolk Constabularies Abnormal Loads Officer.

14.9 The dispensation allows the holder to move agricultural machinery up to a maximum of 4.3 metres (14.10” ft), on public roads within a radius of 25 miles (40.23 Km) of the operating base, without the requirement of giving 24 hours’ notice to the police.

14.10 All movements are subject to compliance with safety conditions, in respect of attendants, signing and ‘self-escorts’. Each machine authorised will have a copy of the dispensation in the driver’s possession and is valid from 1st January to 31st December depending on when they apply or part year thereof from date of issue, back dating of certificates is not permitted in any circumstance.

14.11 These dispensations are granted pursuant to paragraphs 2(4) and 4(2) of schedule 5 to the STGO Regulations which gives discretion to the Abnormal Loads Officer to accept shorter notice periods and fewer details than those otherwise required by schedule 5.

15. Abnormal Load Summary Requirements – Aide Memoire

15.1 The following vehicles are required to give Norfolk and/or Suffolk Constabulary **2** clear days (i.e. 48 hours) notice before any movement can be authorised through the county:

Width:

- Below 2.9m (9’6”) = no notification
- Between 2.9m (9’6”) and 4.3m (14’1”) wide (this being the total width including any projection) = 2 clear days (i.e. 48 hours) written notice

Please Note: *Anything above 3.5m (11’6”) may require a self-escort vehicle*

- Above 5.0m (16’40”) wide = requires VR1 issued by the Highways England

Length:

- Below 18.65m (61’) = no notification
- Between 18.65m (61’) and 27.4m (90’) = 2 clear days written notice.
- For some light loads where the rigid length exceeds 27.4m (89’11”) such as yacht masts moved on conventional motor vehicles not exceeding 12 tonnes gross weight or trailers not exceeding 10 tonnes gross weight a Highways England Special Order will be required.
- Over 30m (98’5”) requires a Special Order issued by Highways England

Please Note: *that the length does not include the traction unit (cab), unless some of the load is being carried on it*

Weight:

- Below 44,000KG = no restrictions
- Between 44,000-50,000KG = 2 clear days’ notice* to Road and Bridge Authorities
- Between 50,000-80,000KG = 2 days police notice and 5 days to Highways England and Bridge authorities
- Between 80,000KG-150,000KG = 2 clear days’ notice to Police and 5 clear days with indemnity to Road and Bridge Authorities
- Over 150,000KG = Highways England Special Order plus 5 clear days’ notice to Police and 5 clear days’ notice with indemnity to Road and Bridge Authorities

**Clear days’ notice excludes Saturdays, Sundays or a public holiday in any part of Great Britain in relation to movements authorised by the Special Types General Order only, there being no such exclusion in Special Orders unless specifically stated.*

15.2 Application to move Special Types or Special Purpose vehicles, such as very large agricultural vehicles, that may not be fully permitted by the

Construction and Use (C&U) Regulations or fall outside the scope of the Special Types General Order should be made to the Vehicle Certification Agency (VCA). The VCA website is http://www.dft.gov.uk/vca/

15.3 Self escort is defined as an accompanying vehicle, operated independently of the Abnormal Load. See Highways England Code of Practice Lighting and Marking for Abnormal Load Self Escorting Vehicles Incorporating Operating Guidance.

(Police escorts can be utilised but at a cost to the haulier)

16. Roles and Responsibilities

Role Title	Responsibilities
Abnormal Loads Officer	As the Abnormal Loads Officer, you are responsible for / must / should do: • The administration and route assessment of notified Abnormal Loads within the County of Norfolk and /or Suffolk. • Receive telephone calls and enquiries regarding Abnormal Loads and issue appropriate permits where necessary. • Determine whether an Abnormal Load requires a Police Escort. • Liaise with other Forces and agencies concerning the movement of an Abnormal Load. • Arrange for routes to be checked regarding extremely large loads. • On behalf of the Chief Constables where appropriate, authorise and issue both General and Agricultural annual Dispensations. • Liaise with the Media Office and the local media of any load movement which may be of public interest. • Give statements and attend Court as a witness when required. • Attend any relevant meetings that are deemed appropriate.
RAPT	You are responsible for / must / should do: • Check that the vehicle, the load and documentation comply with the relevant traffic regulations. Confirm suitability of any undesignated route. • Before commencing escort duties, consideration should be given to the weather, light and traffic conditions. • Warn other road users of the presence of an Abnormal Load and to assist with safe passage.

Appendix A: Self Escort Guide (Suffolk)

Effective from 23rd September 2020

SELF ESCORTS WILL BE EXPECTED WHERE THE BELOW DIMENSIONS ARE EXCEEDED.

Please note: Night movements are not routinely allowed without express permission of the Abnormal Loads Officer.

1. Loads that exceed 4.1m (13'5') wide, 30m (98') or 100 tons in weight

- The A11 south of Barton Mills,
- The A12 south of Ipswich
- The whole length of the A14 from Cambridgeshire to Felixstowe Docks
- (And all the roads below)

2. Loads that exceed 4.0m (13' 1") wide, 30m (98') long or 80 tons in weight

On all other 'A' roads (with the exception of those 3 above)

(And all the roads below)

3. Loads that exceed 3.80m (12' 6") wide, 27.4m (89') long or 80 tons in weight

- The A134**, A143**, A144*&#, A145*&##, A1065* (from A11 to Omar Homes), A1088***, A1092***, A1094 from the A12 to Aldeburgh Golf Club, A1095, A1117, A1152, A1120 roads
- A1071 – Hadleigh to Ipswich Police Escort to be considered
- (And all the roads below)

4. Loads that exceed 3.65m (12') wide, 27.4 m (89') long or 80 tons in weight

- On the A12 through Lowestoft,
- The A134*, A143 & A1302* roads through Bury St Edmunds,
- The A142 through Newmarket,
- The A1101 through Mildenhall from the A11 to R A F Mildenhall & beyond,
- The A1065 through Brandon town,
- The A1071
- The A146 Ellough to Carlton Colville
- The A1117
- (And all road below)

5. Loads that exceed 3.50m (11' 6") wide, 27.45m m (89') long or 80 tons in weight

- The A144 through Halesworth & Bungay #
- The A145 through Beccles, ##
- The A1094 through Aldeburgh from the Golf Club to Church Farm Caravan Park & the Quay,
- The A1095 from the A12 through Southwold to Adnams Brewery & the Quay area,
- The A1304 through Newmarket town
- All 'B' and 'C' class roads, unless a short distance from main 'A' roads - i.e. Carlton Mere (formally Lakeside) Caravan Park, Saxmundham from A12 road at Saxmundham by pass.
- All unclassified roads in the County.

Private Escort vehicles should fully conform to Highways Agency Code of Practice

Loads with excess, width, length, overhang or height will be judged on their individual needs and the haulier will be notified accordingly. This is a guide only and all movements will be assessed by Abnormal Loads Officer according to Force Policy. This guide is subject to change.

* Weight restrictions will prevent loads over 'C&U' weights using these roads (or parts of these roads)

(Suffolk County Council will confirm prohibitions)

** 'Traffic calming' measures will prevent some loads using these roads or parts of these roads altogether.

*** Environmental weight limits will prohibit lower than 'C&U' limits using parts of these roads.

To avoid Bungay town centre the B1062 to the A143 at Homersfield should be used.

To avoid Beccles town centre use the A12, A1117 & A146 roads instead of the A145.

Appendix B: Self Escort Guide (Norfolk

Effective from 23rd September 2020

NORFOLK CONSTABULARY RECOMENDS THE USE OF A SELF ESCORT VEHICLE FOR THE ROUTES BELOW

SELF ESCORTS WILL BE EXPECTED WHERE THE BELOW DIMENSION ARE EXCEEDED.

*****Please Note: No movements during hours of darkness, unless authorised by Abnormal Loads Officer*****

1. Loads which exceed 4.1m (13' 6") wide 30.m (98') long or 100 tonnes

- A11 Thetford to Norwich & reverse
- A47 Wisbech to Acle & reverse
- A12 Gt Yarmouth to Suffolk border & reverse
- A1270 NDR

2. Loads which exceed 4.m (13' 1") wide 30.m (98') long or 100 tonnes

- **^** A140 Scole to Norwich & reverse
- ^ A140 Norwich ring road north to Cromer & reverse
- ^A146 Gillingham north to A47 & reverse
- A10 Kings Lynn south to Cambs border at Brandon Creek & reverse
- A148 Kings Lynn to Cromer & reverse (caution at Letheringsett)
- A143 Scole to junc of A146 & reverse)
- A1066 Thetford to Scole
- A1122 junction of the A10 to A47
- A1067 Norwich to Fakenham
- A1074 junction of the A47 to Norwich
- A1078 junction of A148 to Bentinck Dock, Kings Lynn
- ^ A134 Thetford to junc of A10 & reverse

3. Loads which exceed 3.81m (12' 6") wide 27.4.m (90') Long or 80 tonnes

- A149 (junc of A148) north of Kings Lynn to Hunstanton & reverse
- A149 Gt Yarmouth to Caister-on-Sea & reverse
- A1065 Brandon to Swaffham & reverse

- A1101 Junction of the A47 to Outwell
- A1088 Thetford to Euston
- *A134 Thetford to Bury St Edmunds 3.8m restriction Bury Road, Thetford*(HGV diversion signposted via A11)

4. Loads which exceed 3.65m (12’) wide 27.4m (90’) Long or 80 tonnes

- A1122 Downham Market to Outwell
- A149 Hunstanton to Cromer & reverse
- B1159 Cromer to Caister-on-Sea & reverse
- A143 (Junc of A146) to A12 (Bradwell – Belton – Burgh Castle area’s)
- B1140 – (Junc of A47) south to Cantley - Reedham & reverse
- Brundall boatyards (off A47)
- A1151 Norwich to Smallburgh (serving all boatyards)
- A1062 Hoveton to Potter Heigham (serving all boatyards & Caravan sites)
- A149 Smallburgh to Gt Yarmouth (serving all boatyards)
- Any other ‘B’ class road (unless short distance from ‘A’ roads)
- A1082 junction of A148 to Sheringham

5. Loads which exceed 3.5m (11’ 6”) wide 27.4m (90’) Long or 80 tonnes

- A47 Acle to Great Yarmouth (Acle Straight)
- A1064 Acle to Filby j/w A149
- A1075 Thetford to Dereham
- A1101 Outwell to Welney and border
- All ‘C’ class roads (unless short distance from main ‘A’ roads)

6. Loads which exceed 3.35m (11’) wide 27.4m (90’) Long or 80 tonnes

- A1065 Swaffham to Fakenham (caution at Raynham)
- All unclassified roads in the county

7. Loads which exceed 3.2m (10’ 6”) wide 27.4m (90’) Long or 80 tonnes

- B1436 Felbrigg road to Thorpe Market

8. Any other routes recommended by the Abnormal Loads Officer

- **^ ‘**Traffic calming’ measures will prevent some loads from using these roads or parts of these roads.

- Weight restrictions over 'C and U' Limits on parts of these roads

Please Note: *Loads with excess width, length, overhang or height will be judged on their individual needs and the haulier will be notified accordingly. This is a guide only and all movements will be assessed by Abnormal Loads Officer according to Force Policy. This guide is subject to change.*

HEIGHT RESTRICTION;

Any load over 5m (16'6") High Must inform BT and EDF.

Appendix B
Abnormal Indivisible Load Report for 400kV Cable Drums

Bramford to Twinstead Connection Project - Abnormal Indivisible Load Access for Cable Drums

Prepared for National Grid

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DOCUMENT REVISIONS

Issue	Date	Details
0	08.07.22	Report
1		
2		

Contents

Executive Summary

The contents of this report include land transport feasibility investigations into achieving access to strategic access locations within the area between Bramford to Twinstead where National Grid (NG) is planning to procure cable drums to be delivered as Abnormal Indivisible Loads (AIL) as part of a future development associated with the Bramford to Twinstead reinforcement project.

The sites were inspected for route negotiability in summer 2021. These locations can be found in the maps provided and reproduced within Appendix 2 of this report. Although several sites were initially considered, over the course of the project development the number of cable drum access points has now been reduced to 4. These are as follows from east to west:

1) Access Point AONB East - Quarry
2) Access Point AONB West A134
3) Access Point Stour Valley East Workhouse Green
4) Access Point Stour Valley West.

Whilst information on access points previously considered is available if required it is not reproduced in this report. Routes that were deemed unsuitable based on previous works and those undertaken during 2021 and 2022 are also not discussed in detail within this report which focuses on the preferred routes to each of the sites.

The report also includes a review on the structural status of the preferred routes following consultation with the appropriate highway authorities, including Essex County Council (ECC), Suffolk County Council (SCC) and National Highways South East Region.

The trailer arrangements provided to the structural authorities for consideration in this investigation have been produced to be considerate and representative of those available in the UK heavy haulage market in terms of their suitability on the potential access route from the A12 and A12 trunk roads to site.

National Highways South East Region have advised that although there are some specific structural issues on the A12 and A14 trunk roads most of these can be avoided by using junction exit and entry slip roads although a 112te restriction at Stowmarket is significant as it is on the limit of potential transport configurations gross weights and trailer selection will be important. The 110te restriction at Colchester could potentially be avoided.

National Highways East have advised that where loads are circa 4.5m width then careful consideration of traffic management will be needed as it will impact on network availability and ongoing roadworks.

National Highways are developing a scheme on the A12 near Chelmsford known as the A12 Chelmsford to A120 Widening Scheme. The exact time scales for the commencement of and duration of any works are not confirmed at present and it is recommended that the scheme is monitored as there will be wider traffic management implications not only for AIL access but for general Construction and Use (C&U) traffic associated with the Bramford to Twinstead project.

National Highways are also developing plans for the improvement of the A12/A14 Copdock Interchange at Ipswich. Again, the exact timescales remain unconfirmed, and the scheme should be monitored as it will have a potential impact on wider traffic and transport access requirements.

SCC have advised that the preferred routes identified are structurally suitable for the proposed AILs at this moment in time.

ECC have advised that for access to Stour Valley West, located off the A131 between Sudbury and Halstead the loads are not presently able to use the A131 Town Bridge at Halstead as this has a 44te gross vehicle weight capacity. This is currently being assessed for the much heavier (178te nett) Super Grid Transformer (SGT) loads and will be discussed further in the report to be issued under separate cover, but in 2009 the structure was assessed as acceptable for transformer loads based on a nett transport weight of 137te and in 2012 was reconfirmed by ECC as acceptable for trailers carrying a 169.7te nett transformer. Alternative diversion routes have been discussed with ECC that would avoid Town Bridge, but none have been identified as suitable for cable drums at this time.

Preferred routes to the proposed site access points have been identified and are detailed within the report. All routes to the different sites are considered negotiable from the A12 and A14 trunk roads with appropriate street furniture removal, traffic management and AIL escorts. Access to each site is also expected to be achievable as long as new site access roads are designed and constructed to accommodate the proposed AIL transport arrangements discussed within this report. However, detailed discussions with National Highways East, SCC and ECC and the police forces will be required to confirm escort and traffic management implications once the number and date of AIL deliveries is clarified.

No major concerns have been expressed by Essex Police and Norfolk and Suffolk Police, who work as a combined force for roads policing across the two counties. There may be a value in having a joint meeting in the future to discuss route requirements once exact delivery requirements in terms of numbers and dates are known as well as the appointed haulage contactors. It is expected that a police escort would be required for the loads from the A12 or A14 to site due to their width with private escort arrangements also in place and it is recommended that further discussions are undertaken with respect to confirming escort requirements prior to deliveries.

No specific Swept Path Assessments (SPA) are thought necessary at this time on the proposed routes to the Access Points highlighted for cable drum AILs.

No specific consideration of the internal haul road providing access between various laydown areas in the development area has been included and it is assumed that the contractor will design this to be able to accommodate the AILs required. A detailed appraisal of the technical requirements for handling components on-site will be required as the scheme progresses in the future. It may potentially be feasible to use the proposed internal haul roads to move cable drums between access points that can be used and other locations within the cable corridor although specific consideration of this is outside of the remit of this report. No specific consideration of onsite access within the sites themselves has been included with all route investigations ceasing at the point at which the public road access to the site is proposed to be constructed.

The report is intended to be a summary of the Abnormal Indivisible Load (AIL) route access at the current time and is not a guarantee that the route will be cleared in the future. Specific movements will need to be assessed at the time on an individual basis.

This report is specific to cable drum access only. Separate reports will be available for reactor and Super Grid Transformer (SGT) access to other locations at Bramford and Twinstead respectively. No consideration is provided in this report for wider construction access requirements to overhead towers for items such as cranes and piling riggs.

1. Introduction

1.1. The contents of this report include land transport feasibility investigations into achieving access to strategic access locations within the area between Bramford to Twinstead where National Grid (NG) is planning to procure cable drums to be delivered as Abnormal Indivisible Loads (AIL) as part of a future development associated with the Bramford to Twinstead reinforcement project.

1.2. This will see cable drum deliveries to the projects' construction site access via the public highway network, which are expected to commence in 2023. It is understood that the cable drums could be delivered via any UK port and transported to the region by road and for the purposes of this enquiry, a review of access to the site access locations from the A12 and A14 trunk roads has been undertaken. Although no detailed appraisal of marine access at potential ports of access has been undertaken there are various ports in the South East that are able to accommodate the project cargo from where deliveries can be managed to each site access point by road.

1.3. This report is a summary of the status of the current AIL access investigations and seeks to present the situation as it currently stands. The issues highlighted in this report as risks to achieving AIL access in the future, will need to be revisited and progressed as the scheme develops upon confirmation of the exact dimension of cable drum sizes.

1.4. This investigation considers the potential land transport routes from the A12 and A14 trunk road based on the assumption that movements will take place under Special Types General Order (STGO) Regulations.

1.5. At the commencement of the works during summer 2021 it was anticipated that a full review of access to numerous sites as were considered in previous works on this scheme in 2012 would be considered. This was for four (4) preferred routes to sites within the Twinstead to Bures Study Area to the west of the Stour Valley and to a further eight (8) sites within the Leavenheath to Polstead study area to the east of the Stour Valley.

1.6. However, as the project has progressed, NG has now distilled the potential cable drum access points to four (4) locations as below. Therefore, no specific reference is made to the sites that are no longer under consideration for access or for the various potential AIL routes to them that have now been rejected. In addition, routes that are deemed unsuitable for cable drum access to the 4 locations now being considered are not specifically discussed within this report but further background information on these is available if required by NG.

1.7. Assuming an east-west direction from Bramford to Twinstead the four locations now proposed for cable drum access for the Bramford to Twinstead reinforcement project are:

5) Access Point AONB East - Quarry
6) Access Point AONB West A134
7) Access Point Stour Valley East Workhouse Green
8) Access Point Stour Valley West.

1.8. The proposed access points can be found in the Figures reproduced in Appendix 1 of this report.

1.9. NG have had a 3D laser survey undertaken by others to inform on physical access to the proposed cable drum access sites. However, where relevant, this report also includes reference to route negotiability of the preferred routes to each site.

1.10. No consideration of the internal haul road providing access between the various laydown areas in the development site is included and the route surveys end at the point at which site access is proposed to exit the public highway. A detailed appraisal of the technical requirements for handling components on-site will be required as the scheme progresses in the future.

1.11. The report is intended to be a summary of the access for cable drum AIL requirements at the current time and is not a guarantee that the route will be cleared in the future. Specific movements will need to be assessed at the time on an individual basis. If any further information is required, it is available on request. No allowance has been made for AILs associated with the proposed Twinstead Grid Supply Point (GSP) Substation or Bramford Substation including access for heavy transformers which are expected to be required for access. This will be detailed in separate reports.

1.12. No allowance is made for Construction and Use and general traffic requirements including traffic management plans that may be associated with the wider development plan and no specific discussion is included in this report in terms of access to the overhead line sections of the scheme for mobile cranes and piling riggs.

2. National Highways and Legislative Requirements

2.1. *Definition of Abnormal Indivisible Load (AIL)*

2.1.1. The Department for Transport, of which National Highways (NH), formally Highways England, is a government-owned company with responsibility for managing the core road network in England, state that the strict definition of an AIL refers to a load which cannot, without undue expense or risk of damage, be divided into two or more loads for the purpose of carriage on roads and which, owing to its dimensions or weight, cannot be carried on a vehicle which complies in all respects with the ‘standard vehicle regulations’ these are:

- The Road Vehicles (Construction and Use) Regulations 1986 (as amended)
- The Road Vehicles (Authorised Weight) Regulations 1998 (as amended)
- The Road Vehicles Lighting Regulations 1989 (as amended).

2.1.2. All equipment should be stripped of their ancillaries before they are transported. NH will only accept that further dismantling is not required where it cannot be economically achieved due to the requirement for its construction within specific factory environments or where extremely high tolerances have to be maintained.

2.2. *Legislation*

2.2.1. Conventional heavy goods vehicles have an operating weight limit of 44 tonnes. The category known as abnormal indivisible loads (AIL) covers those vehicles where the gross weight exceeds 44 tonnes. An Abnormal Load is defined as that which cannot be carried under Construction and Use (C&U) Regulations. Items which, when loaded on the load carrying vehicle exceed the weights encompassed by the C&U Regulations, but do not exceed Special Order Permission Limits, are governed by Special Types General Order (STGO) categories 1 to 3 depending on size. Where dimensions exceed 6.1m in width, 30m in rigid length or 150 tonnes gross weight, Special Order from NH is required. NH have issued an aide memoire that explains notification requirements in more detail. This document has been attached as Appendix 3.

2.2.2. Special Order category AIL movements are authorised by the NH Abnormal Loads team, based in Birmingham.

2.2.3. STGO loads orders grant consent for loads that satisfy the following criteria:

Category 1 weight	44 – 50 tonnes and 11.5te axle weights
Category 2 weight	50 – 80 tonnes and 12.5te axle weights
Category 3 weight	80 – 150 tonnes and 16.5te axle weights
Width Restriction	3.0m (C&U) –5m (VR1 Required) – 6.1m (SO Required)
Length Restriction	18.65m (C&U) – 30.0m rigid (SO Required)

2.2.4. The cable drums considered within these investigations are expected to be transported at STGO Category 2 or 3. Such loads are required to provide two clear working weekdays notice to be given to the Police forces on the route and are required to provide 5 clear working weekdays notice together with an indemnity to the highway and bridge authorities on the route.

2.2.5. As the loads considered in these investigations are within STGO and therefore no specific consideration of Special Order requirements, including the Department for Transports (DfT) Water Preferred Policy for AILs is considered necessary and no specific marine access investigations are included.

2.3. As the loads are not restricted to Special Order requirements they will not necessarily be delivered to the nearest port although it is expected that an east coast port would be potential delivery locations subject to route approval at the time of requirement. It was assumed at the commencement of investigations that this will be feasible without difficulty for the proposed loads. The final approach to the sites from the A12 and A14 is discussed in terms of structural clearance in Section 6.

3. Abnormal Indivisible Load Movements - Highways Act 1980

3.1. *Recovery of Excessive Maintenance Costs - Section 59 Agreements*

3.1.1. Section 59 of the Highways Act 1980 allows the highways authority to raise a charge against a user of the highway to cover repair works necessitated by excessively heavy or unusual loads being carried on the road by that user. This provision is typically used where the passage of heavy lorries to and from industrial premises or building sites causes excessive damage to the road, requiring expensive remedial works by the Council. Under Section 59, the Council may charge on such costs to the organisation responsible for the damage, the amount payable being calculated as the excess cost of repair compared to normal maintenance costs for the road. Rather than wait to be charged such excessive repair costs, the Council and the third party may enter into an agreement under Section 59 whereby the third party accepts liability and makes payment of an agreed sum to the Council to cover the excessive repair costs.

3.2. *The Removal and Replacement of Street Furniture*

3.2.1. Where the removal and replacement of street furniture is required for the mobilisation of out of gauge vehicles into existing sites then these are generally managed under Temporary Traffic Regulation Order (TTRO) and Street Works Legislation. These are normally, but not necessarily, organised by the haulage contractor. These requirements are generally to ensure that the supervisors and operatives are competent and that the works will be carried out to a prescribed standard with the appropriate traffic management in place. In some circumstances the Highway Authority or LA will insist that their preferred contractors carry out such work.

4. Plant Dimensions Included within Study Work

4.1. Table 1 shows dimensions of the cable drums that has been included within the study for initial feasibility assessment work, which were advised by the client. These dimensions have been used to derive indicative transport arrangement drawing discussed in Section 5 for presentation to the structures team within the Highway Authorities as detailed in Section 6. It is understood that the drums will require a cradle for transport and that the cable drum cradles will be part of the cable shipment.

Table 1. Selected Items to be considered.

Item	Weight	Diameter	Length/Depth
Cable drums	60 te	4.5 m	6.0 m

4.2. The information included within this report is based around a selection of different manufacturing contractor's potential equipment. All details of possible transport dimensions should be treated with caution and be understood to be in need of clarification as the scheme progresses.

5. Transport Configurations

5.1. *Cable Drums*

5.1.1. The dimensions of the cable drum component expected to require delivery to the site which has been considered in these investigations is detailed in Table 1 previously discussed.

5.1.2. Due to the size of the components it is not possible to transport them under the regulations governing Construction and Use (C&U) vehicles (44 tonne gross, 18.65 m long and 2.9 m wide). It is therefore necessary to transport within the Special Types General Order (STGO) regulations as previously discussed.

5.1.3. There are numerous haulage contractors with equipment able to carry the cable drums within STGO Category 2 and 3 and these have been used to inform and produce the conceptual transport drawing considered within this report. As various haulage contractors are available, competitive tendering for the transport of cable drums is viable.

5.1.4. It is assumed that road transport configuration would utilise a bed trailer or low bed type configuration or a self-spooling modular trailer. The following transport drawings have been produced and are reproduced in Appendix 1:

- Drawing Number 21-1030.TC01 Bramford to Twinstead cable drum 4 axle spooling trailer transport configuration
- Drawing Number 21-1030.TC02 Bramford to Twinstead rotated cable drum 2 axle bed 4 axle goose neck trailer transport configuration R0
- Drawing Number 21-1030.TC03 Bramford to Twinstead cable drum 4 axle trailer transport configuration R0
- Drawing Number 21-1030.TC07 Bramford to Twinstead 60 te cable drum 2 axle bed 4 axle spooling trailer R0-Sht 1 of 1

5.1.5. The trailer arrangement provided to the structural authorities for consideration in this investigation has been produced to be considerate and representative of those available in the UK heavy haulage market in terms of their suitability on the potential access route from the A12 and A14 to site. This does have relatively high axle loads of 16.5te on the 2 rear tractor axles, and is therefore only just able to remain within STGO. This is as per Drawing Number 21-1030.TC01 with tractor axle loads 3 and 4 at 16.5te being the heaviest loads and as such being the focus of structural investigations and having been submitted to structural authorities for comment

5.1.6. An alternative in the event that axles loads prove an issue in terms of structural clearance is to add 2 axles to the trailer arrangement below the neck of the trailer to reduce loadings as shown in Drawing Number 21-1030.TC07. However, this will increase the length of a delivery vehicle. It would be advisable for this larger arrangement to be considered in initial site access considerations as it is more onerous in terms of physical negotiability requirements.

5.1.7. The responses to these investigations are discussed in Section 6. The physical negotiability of these vehicles on the proposed routes is discussed in further detail in Section 7.

5.1.8. If the worst case 4.5 m height/diameter is assumed, it would be advisable for the Cable Drums to be carried on a low loader/low bed trailer such that they are below 4.95 m transport height to meet with standard UK motorway and trunk road running heights.

5.1.9. It should be noted that the transport drawings assume a worst case in terms of physical negotiability requirements due to an outside track (bogie width) of 3.0 m being proposed. It is anticipated that it will also be possible to procure transport arrangements with reduced width of trailer bogies.

6. Structural Route Information

6.1. *Cable Drum Access*

6.1.1. As the loads are not restricted to Special Order requirements, the cable drums could arrive via any UK port and travel to the region by way of the motorway and trunk road network. In our experience this will be feasible without difficulty for the proposed loads based on the use of the primary trunk road and motorway network for STGO AILs. The A12 and A14 are the main arterial routes providing access to East Anglia to the entire UK at STGO dimensions and the routes to each of the sites are detailed below.

6.1.2. Numerous routes were investigated for access to the study sites and preferred routes to each of the 4 development sites as detailed in Section 1.7. The preferred routes detailed below were proposed following route inspections and detailed review of historical AIL access routes in the region, as well as knowledge obtained from previous similar works undertaken in 2012.

6.1.3. Essex Police and Norfolk and Suffolk Police, who work as a combined force for roads policing across the two counties, were also approached for comment on the routes submitted for consultation and a meeting was held with Norfolk and Suffolk Police on 30.06.21 to inform them of the proposals. The draft notes have been circulated to NG previously and are not reproduced in this report. In addition, NG also took the police on a site/route inspection in July 2021 to highlight the requirements of the project.

6.1.4. An updated AIL policy document providing general advice on the guidance for AIL movements in the two counties was produced by Norfolk and Suffolk Police in February 2021 and this is attached within Appendix 4 for information and reference.

6.1.5. The two counties also work in close coordination of AILs with Essex police force areas when loads crossed the county boundaries which will be the case for the cable drums in the western area of the Bramford to Twinstead project. It is common for one force to take an AIL through another forces area for example. There may be a value in having a joint meeting in the future to discuss route requirements once exact delivery requirements in terms of numbers and dates are known as well as the appointed haulage contactors.

6.1.6. No specific issues have been identified although it is expected that a police escort would be required for the loads from the A12 or A14 to site due to their width with private escort arrangements also in place and it is recommended that further discussions are undertaken with respect to confirming escort requirements prior to deliveries with the police forces.

6.2. *A12 and A14 Trunk Road Network*

6.2.1. The main focus of this report is in terms of the final approaches to the 4 cable drum access points from the trunk road network. However, an overview as to the status of the A12 and A14 trunk road network is worthy of note and National Highways East Region were asked for their initial thoughts on the status of the A12 and A14.

6.2.2. This is based on the assumption that STGO cable drum loads could be brough into the area from the west, potentially from any port of entry. It should however be noted that east coast ports such as Great Yarmouth, Ipswich, Kings Lynn and Lowestoft are also available for cable drum delivery and storage and therefore could also be used for entry into the UK. Commercial considerations will ultimately drive where the appointed cable drum manufacturer and their haulage contractor will import the cable drums from.

6.2.3. National Highways East were advised that possible egress could be at the following junctions from either direction:

- A14 – A134 Jct 44 at Bury St Edmunds
- A14 – A1214 Jct 55 at Ipswich
- A12 – A1124 Jct 26 at Colchester. Load could exit north towards Halstead or south and east to Colchester.
- A12 – Jct 27 eastbound at Colchester.
- A12 – Jct 28 at Colchester Football Club. Note this may then need the bridge carrying the B1508 over A12 Colchester Road to be considered.
- A120 – A131 Jct at Braintree
- A120 – B1024 Colne Road Jct at Coggeshall Bypass

6.2.4. Proposed cable drum loads were submitted to National Highways following a meeting held on 30.05.21. The key load was advised as being the 4 axle spooling trailer as per Drawing Number 21-1030.TC01 which has high axle loads of 16.5te on the 3rd and 4th tractor axles as previously highlighted. National Highways responded on 15.09.21 (Appendix 7) with a summary of the status of the A12 and A14 as detailed below.

6.2.5. In terms of the A14 there are numerous known structural weight limitations, but these can be managed at junctions 42, 43, 44, 50 and 51. The most onerous to avoid is Newton Road which will require rerouting through Stowmarket for loads in excess of 112te gross. The details and locations of these restrictions as advised by National Highways East are reproduced below.

- 112 tonne limit; A14 Junction 42 Bury St Edmunds Western 10014 A14/142.60// Western I/C East 582678E_265427N best use the slip roads
- 112 tonne limit; A14 Junction 42 Bury St Edmunds Western 10015 A14/142.50// Western I/C West 582520E_265455N best use the slip roads
- 112 tonne limit; A14 Junction 43 Bury St Edmunds Central 10009 A14/145.60// Central I/C East 585692E_265316N best use the slip roads
- 112 tonne limit; A14 Junction 43 Bury St Edmunds Central 10010 A14/145.50// Central I/C West 585561E_265393N best use the slip roads
- 112 tonne limit; A14 Junction 44 Bury St Edmunds East 10004 A14/147.70// Eastern I/C East 586755E_263607N best use the slip roads
- 112 tonne limit; A14 Junction 44 Bury St Edmunds East 10005 A14/147.60// Eastern I/C West 586650E_263654N best use the slip roads

- 112 tonne limit; A14 Stowmarket 09978 A14/167.80// Newton Road 604948E_259692N route through Stowmarket
- 52 tonne limit; A14 Junction J50 09971 A14/170.10// Cedars I/C South 606860E_258500N best use the slip roads
- 52 tonne limit; A14 Junction J50 09972 A14/170.00// Cedars I/C North 606760E_258565N best use the slip roads
- 52 tonne limit; A14 Junction J51 09960 A14/176.00// Beacon Hill I/C South 610840E_254200N best use the slip roads
- 52 tonne limit; A14 Junction J51 09961 A14/175.90// Beacon Hill I/C North 610770E_254290N best use the slip roads

6.2.6. Most of the restrictions can be avoided by using junction exit and entry slip roads although the 112te gross weight restriction at Stowmarket is significant as it is on the limit of potential transport configurations gross weights and trailer selection will be important. A diversion via Stowmarket is available and has been used for SGTs for Burwell Main in the past but it would be preferable to avoid having to use this diversion if possible by keeping weights below 112te.

6.2.7. In terms of the A12 there are also known structural weight limitations as advised by National Highways East and reproduced below.

- 140 tonne limit; A12 Junction J25 24331 A120/59.60// Marks Tey Rail 591171E_223637N A12 to A120 East and Westbound
- 90 tonne limit; A12 Junction J29; 05872 A12/81.60// Whitehouse 601980E_229220N northbound from J29 A120 west/northbound. *Wynns comment – This is the link from A120 roundabout south of A12 so would not impact if going straight on A12 but may if come off here to go north.*
- 132 tonne limit; A12 Stratford St Mary 05887 A12/87.90// Church Bridge Stratford 605085E_234633N both directions
- 110 tonne limit; A12 Colchester 05860 A12/75.20// Orchard Railway 597199E_226419N both directions *Wynns comment – AIL is 108te so right on limit.*
- 140 tonne limit; A120 near Braintree 24329 A120/48.0// Blackwater 580690E_223122N both directions River Blackwater crossing. *Wynns comment. This is on A120 between Braintree and Cogenhall.*

6.2.8. The 110te restriction at Colchester is significant. Of the trailers produced only drawing number 21-1030.TC01 (4 axle spooling trailer) is currently below this weight. Other configurations are above 110te. National Highways advises that the AIL could potentially reroute through Colchester and re-join the A12 at junction 28 or 27 thus avoiding Orchard Railway but also highlight that there is a 90 te weight limitation at Whitehouse but this can be avoided by continuing westward and doing a U-turn at A12 Junction 28. The 90te limit on Whitehouse Bridge would only apply if AIL came in from Colchester (or Harwich) as it is the link back to A12 north and would be crossed under if remaining on the main carriageway but can be avoided.

6.2.9. National Highways East have advised that where loads are circa 4.5m width then careful consideration of traffic management will be needed as it will impact on network availability and ongoing roadworks. Early engagement with National Highways East is advisable to confirm suitable movement requirements including timings.

6.2.10. In addition, it should be noted that National Highways are developing a scheme on the A12 near Chelmsford known as the A12 Chelmsford to A120 Widening Scheme. Wynns submitted information on 23.06.21 with regards to the wider impact on STGO loads for the new A12 proposed near Chelmsford and National Highways confirmed that this has been received and recorded, and will be forwarded to their analysis team to process and will feed into an independent consultation report.

6.2.11. National Highways technical team acknowledge that any changes to the A12 in terms of structures, should be considerate of heavy load requirements. This would include loads transported at the top end of STGO up to 150te gross weight by road on the A12 as is the case with the proposed cable drum loads. They have also confirmed that the A12 between junction 19 and junction 25 is on Heavy Load Route 82 and therefore is required to carry heavy load vehicle classification D Special Order vehicles of gross trailer weight 264.16 tonnes on 12 axles or 299.72 tonnes on 14 axles. Classification D vehicles are equivalent to SOV-350 vehicles in line with NA to BS EN 1991-2. This would therefore adequately accommodate the AIL vehicle proposed for the cable drum access.

6.2.12. Further information on the project is available here.

https://nationalhighways.co.uk/our-work/east/a12-chelmsford-to-a120-widening-scheme/

6.2.13. The exact time scales for the commencement of and duration of any works are not confirmed at present and it is recommended that the scheme is monitored as there will be wider traffic management implications not only for AIL access but for general Construction and Use (C&U) traffic associated with the Bramford to Twinstead project.

6.2.14. National Highways are also developing plans for the improvement of the A12/A14 Copdock Interchange at Ipswich. No specific response to the public consultation has been submitted by Wynns in respect to this scheme. An options report was issued by National Highways in March 2022 and the project remains in development. Again, exact timescales remain unconfirmed and the scheme should be monitored as it will have a potential impact on wider traffic and transport access requirements to the Bramford to Twinstead project. Further information is available on the project website as per the link below:

https://nationalhighways.co.uk/our-work/pipeline-of-possible-future-schemes/a14-junction-55-copdock-interchange/

6.2.15. In summary, whilst there are no major limitations to access on the A12 and A14 it is recommended that dialogue is maintained with National Highways East at a strategic level to keep them advised of the overall scheme developments and timescales in order that there will be minimal disruption. Final cable drum weights will also need to be considerate of the weight limitations advised on A12 and A14 so that they can either be adhered to or avoided by the highlighted diversions.

6.3. *Access Point AONB East - Quarry*

6.3.1. The preferred route to AONB East - Quarry is detailed below.

- From A14/A12 interchange at Ipswich take A1214 towards Ipswich
- Turn left A1071
- Continue A1071 via Hintlesham, Hadleigh
- Turn left unclassified Hadleigh Heath at OS Reference TM 002 418
- Continue to potential site access at OS Reference TM 011 402

6.3.2. Figure 1 shows the proposed site access location as provided by NG.

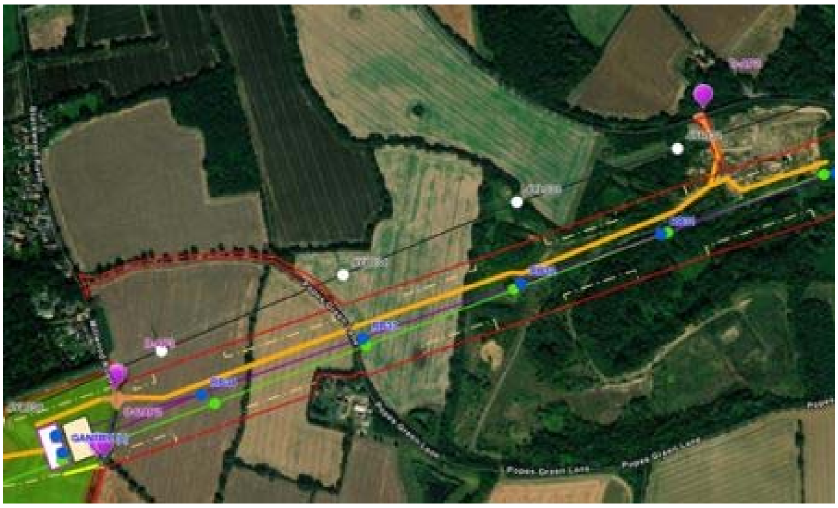


Figure 1. ANOB East Quarry location access point

6.3.3. The route has been cleared by the structural authorities including Suffolk County Council (SCC) and is structurally acceptable.

6.4. *Access Point AONB West A134*

6.4.1. The preferred route to AONB West A134 is detailed below.

- Exit A12 at Jct 28, traveling south towards Colchester town center on Northern Approach Road Via Urbis Romanae
- Turn right A134
- Continue to site access location at approximate OS Reference TL 9510 3777 just north of the B1068 Stoke Road junction

6.4.2. Figure 2 shows the proposed site access location as provided by NG.

Figure 2. ANOB West A134 location and access plan

6.4.3. The route has been confirmed as acceptable in terms of structures by both Essex County Council (ECC) and SCC.

6.4.4. SCC initially expressed some concern in reference to structure number 1642 which is a culvert on the A134 Nayland Bypass. However, after further review they confirmed in April 2022 that the structure is able to accommodate the prosed AIL.

6.4.5. The access from the A12 to the south is considered the preferred route. However, the A134 runs North to South from the A14 at Bury St Edmunds to the A12 at Colchester and could be utilised from either of the main trunk roads. SCC have advised that the 4 axle spooling trailer with 16.5te axle loads would require further assessment on a structure south of Bury St Edmunds on A134 if exiting the A14 this way. This is structure number 2828 (Old Victoria Culvert) about 3 miles south of Bury St Edmunds and this has an axle weight limit which is less than the 16.5te maximum axle weight although the exact axle weight requirement has not been confirmed to date by SCC. This could potentially be overcome by additional axles to reduce axle weights to acceptable levels. The culvert is at 2m a small span and remedial measures or further assessment could also potentially be considered if necessary but as a route from the south exists this has not been progressed further at this time .

6.4.6. Access by way of extending the access from the A12/A14 Copdock junction from the east as per 6.3 is not presently considered suitable by SCC. This is due to a 44te gross weight restriction at Boxford (Boxford River Bridge) on the A1071 which prevents access to the A134. It is understood that SCC has a lack of information on acceptable capacity. SCC are trying to get it improved and to be SV100 gross nominal capacity as it is a principle road. At present it is 44te C&U and should be discounted but this may change in the future. There are no other concerns for STGO loads on the A1071.

6.5. *Access Point Stour Valley East Workhouse Green*

6.5.1. The preferred route to Stour Valley East Workhouse Green is detailed below.

- Exit A12 at Jct 28, traveling south towards Colchester town center on Northern Approach Road Via Urbis Romanae
- Turn right A134
- From A134/A131 junction on Sudbury bypass take A131 Newton Road
- Turn left B1508 Cornard Road
- Continue B1508 to site approx OS Reference TL 896 370

6.5.2. Figure 3 shows the proposed site access location as provided by NG.

Figure 3. Stour Valley East Workhouse Green location and access plan

6.5.3. The route has been confirmed as acceptable in terms of structures by both Essex County Council (ECC) and SCC.

6.5.4. The comments in terms of the A134 from the north also apply in terms of the alternative route from the A14 at Bury St Edmunds.

6.6. *Access Point Stour Valley West.*

6.6.1. The preferred route to Stour Valley West is detailed below.

- From M11 junction 8 take A120 east
- Continue A120 via Braintree
- At Coggershall Road roundabout continue A131
- Turn right A131 Broad Road
- At High Garret turn right A131 Halstead Road
- Continue A131 via Halstead to approx. OS Reference TL 8418 3540 where temporary access haul road to Twinstead site would be constructed.

6.6.2. Figure 4 shows the proposed site access location as provided by NG.

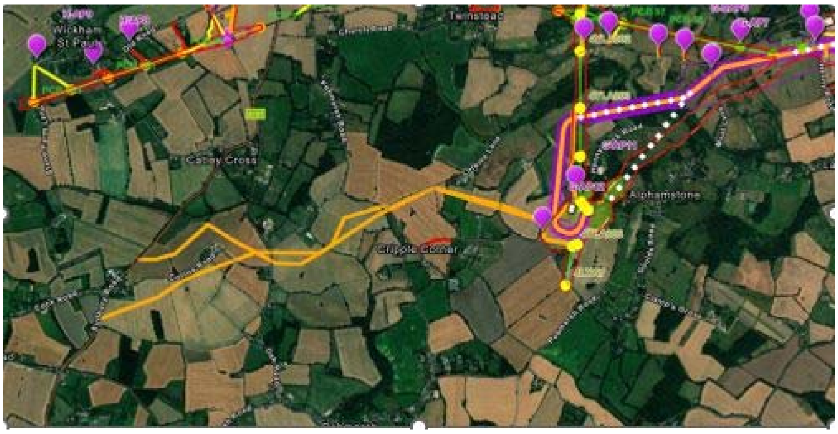


Figure 4. Stour Valley West location and access plan

6.6.3. The route proposed is the same that would be expected to be used for SGT for the new Twinstead Grid Supply Point (GSP) Substation and this will be discussed in further detail within the SGT access report. However, at present the A131 is limited by Town Bridge at Halstead which has been advised as unsuitable for all AILs above 44te gross. This is currently being assessed for the much heavier (178te nett) SGT loads and will be discussed further in the report to be issued under separate cover, but it is worthy of note that in 2009 the structure was assessed as acceptable for heavy transformer loads based on a nett transport weight of 137te and in 2012 was reconfirmed by ECC as acceptable for trailers carrying a 169.7te nett transformer.

6.6.4. Presently ECC are advising the bridge remains unsuitable for cable drum vehicles, but this may change after the assessment.

6.6.5. Alternative diversion routes have been discussed with ECC that would avoid Town Bridge and these are briefly discussed below in table 2 but none have been identified as suitable for cable drums at this time. In addition, it should be noted that even if one of these options was available for cable drums it would not be feasible for SGT delivery and as such, as further assessments or remedial works may be needed to confirm SGT delivery it would be appropriate for such works to be considerate of cable drums access as well so that there is a common construction route for Twinstead AILs rather than a different route being proposed for SGTs and cable drums.

Table 2. Diversions to avoid A131 Halstead Town Bridge for Cable Drums considered

Diversion	Notes	Suitable (Yes/No)
West of Halstead town centre via Chaple Hill, Sloe Hill, White Ash Green and Bradleys Lane to the A1124 to approach Halstead from the west to re-join A131 north of Town Bridge.	It is understood some smaller AILs are diverting this way to avoid Town Bridge. However, the route would not be accessible on Bradleys Lane due to its narrow width without remedial works including tree and hedgerow pruning.	No
From A120 at Coggeshall via the B1024 to the A1124 at Earls Colne and A1124 to Halstead to re-join A131 north of Town Bridge	Bridge no 50/42640 Stone on the A1124 about 2.5miles east of Halstead is advised by ECC as structurally unsuitable for the proposed loads. No survey has been undertaken of this route other than from desk top review.	No
Exit A131 at High Garret onto A1017 northbound to A1124 via Gosfield.	Not specially investigated but historical information indicates a 44te gross weight limit on A1017 at Gosfield Bridge.	No

6.6.6. The route via A131 does not enter Suffolk and as such SCC have no objections. Alternatives are not considered appropriate from the north via Sudbury.

6.7. *Structural Summary.*

6.7.1. It can be demonstrated that there are provisional routes to the three easterly sites at Access Point AONB East – Quarry, Access Point AONB West A134 and Access Point Stour Valley East Workhouse Green.

6.7.2. For Access Point Stour Valley West, the preferred route is to the proposed haul road to be constructed on the A131, but this is dependent on the results of the ongoing structural assessment of Town Bridge for SGT AILs. The cable drum AILs are considered to be less onerous at SGT than the SGT loads and as such if the SGT loads pass then it can be assumed the cable drum load will also.

6.7.3. Access will be subject to the final dimensions of cable drums and trailer arrangements being confirmed and the exact requirements will be confirmed by the appointed haulage contractor prior to actual deliveries. This will include all escort requirements with the police.

7. Route Negotiability

7.1. *Access Point AONB East - Quarry*

7.1.1. The following notes and photographs describe this route negotiability of the preferred route.

Photograph 1

Copdock Interchange. Vehicle enters from behind camera and drives forward on to the A1214.

Photograph 2
A1214/A1071 crossroads. Vehicle approaches from right and turns left towards camera onto A1071. Full occupation of carriageway required.

7.1.2. The Wynns survey team were in the area in June 2021 and noticed a new road layout under construction on the link from A1214 to A1071. This was investigated with Suffolk County Council, who have advised (email 21.06.21) that the works formed part of the 'Wolsey Grange highway improvement scheme' and when completed, will have widened part of the A1071, and in turn should improve negotiability for the AIL vehicle turning from the A1214 on to the A1071. In addition to this, the traffic signal posts are socket mounted to allow for removal if required. No design drawings have been obtained by Wynns as the scheme has yet to be completed, but it is not thought to cause any negotiability issues for the loads discussed within this report.

Photograph 3
Bridge carrying A1071 over A14. Vehicle moves towards camera. No structural concerns identified by National Highways East. The bridge has been cleared for Special Order loads to Bramford Substation in the past.

Photograph 4

A1071/B1113 Swan Hill Roundabout. Vehicle approaches camera, travelling straight over the roundabout. Expected to be negotiable for cable drum access. Note that the roundabout has been accessed by 28 axle trailers in 2018 for loads to Burstall Substation which is adjacent to Bramford, where the loads turn right at this roundabout.

7.1.3. The A1071 from Swan Hill roundabout to the site is considered negotiable for the proposed loads. However, there will be a need for the appointed haulage contractor to agree exact escort and traffic management requirements with the police as there will be sections of the A1071 where the AIL will require to utilise the full width of the carriageway including crossing over solid white lines. Example photographs of typical locations are shown below.

Photograph 5

A1071. Vehicle approaches camera. Example of where full road width will be required under police escort with consideration of traffic management.

Photograph 6

A1071 at Hintlesham. Vehicle approaches camera. Example of where full road width will be required under police escort with consideration of traffic management.

Photograph 7

A1071 at Hintlesham. Vehicle approaches camera. Example of where full road width will be required under police escort with consideration of traffic management.

Photograph 8

A1071. Vehicle approaches camera. Example of where full road width will be required under police escort with consideration of traffic management.

Photograph 9

A1071. Vehicle approaches camera. Example of where full road width will be required under police escort with consideration of traffic management.

Photograph 10

A1071. Vehicle approaches camera. Example of where full road width will be required under police escort with consideration of traffic management.

Photograph 11

A1071. Vehicle approaches camera. Example of where full road width will be required under police escort with consideration of traffic management.

Photograph 12

A1071/B1070 junction at Hadleigh. Vehicle approaches camera. Expected to be negotiable without removal of street furniture depending on the final width of load but centre island could be removed if needed.

Photograph 13

A1071/UC road at Hadleigh Heath providing access to Layham Quarry. Load turns left away from camera. The junction is negotiable by cable drum load requirements.

Photograph 14

A1071/UC road at Hadleigh Heath providing access to Layham Quarry. View looking east. Load approaches from right and turns left towards camera. The junction is negotiable by cable drum load requirements.

7.1.4. The access road to the Layham Quarry is excellent and has in the past been well used by HGVs accessing the quarry which is now closed and is of sufficient width for HGVs to pass without difficulty.

Photograph 15

Hadleigh Heath UC road providing access to Layham Quarry which is on the right. It is assumed National Grid will develop access from this point to the internal haul road requirements for cable drum installation.

7.2. *Access Point AONB West A134*

7.2.1. The potential route to exit the A12 at junction 28, near the Colchester United Football Club Stadium and traveling south towards Colchester town center Via Urbis Romanae to the A134 only become apparent as an option after the field survey and no detailed photographs are available. However, the route has been driven in the past and a high level review of desktop mapping and satellite photography has been undertaken. It is expected that this route will be negotiable although confirmatory surveys would be advisable prior to movement, as with all routes.

7.2.2. The first section of the route from the A12 to A134 is via new roads and these are wide enough for the AIL. The A134 north towards Sudbury and Access Point AONB West A134 is also negotiable although there will be a requirement for the appointed haulage contractor to agree the exact escort and traffic management requirements with the police as there will be sections where the AIL will require to utilise the full width of the carriageway.

7.2.3. There will also potentially be a need to remove street furniture at the following locations depending on the final width of transport arrangement selected for delivery of cable drums:

- mini roundabout at Nayland Road/Northern Approach,
- centre island just north of Brick Kiln Lane
- centre island just south of Coach Road
- centre island at the Yew Tree Public House
- centre island just north of School Lane

7.3. *Access Point Stour Valley East Workhouse Green*

7.3.1. Access is assumed to be north on the A134 as far as Access Point AONB West A132 described in Section 7.2 is the same from which point the route continues north to Sudbury unrestricted on the A134 and A131 the junction with the B1508 Bures Road that provides access to Workhouse Green.

7.3.2. In addition to the items in 7.2.3 there will also potentially be a need to remove street furniture at the centre island at the A134/A1071 junction

7.3.3. The following notes and photographs describe route negotiability of the preferred route from the A131/B1508 junction near Sudbury leisure centre to the proposed site access.

Photograph 16

A131/B1508 junction in Sudbury. Load moves away from camera and turns left. This roundabout is expected to be negotiable with full occupation of the carriageway. However, depending on the final size and width of cable drum and trail utilised for movement, it is possible that the railings on the inside of the turn will need to be removed to facilitate access.

Photograph 17

A131/B1508 junction in Sudbury. Load moves away from camera and turns left. This roundabout is expected to be negotiable with full occupation of the carriageway. However, depending on the final size and width of cable drum and trail utilised for movement, it is possible that the railings on the inside of the turn will need to be removed to facilitate access.

Photograph 18

B1508 Cornard Road, Sudbury. Load moves away from camera. Negotiable with full occupation of the carriageway.

Photograph 19

B1508 Cornard Road/Cats Lane roundabout. Load moves away from camera. Approximate width 4.8m. Expected to be negotiable but removal of the centre island street furniture could be required depending on the final width of trailer selected for movement.

Photograph 20

B1508 Cornard Road. Load moves away from camera. Caution parked cars. Parking restrictions would be advisable.

Photograph 21

B1508 Cornard Road/Head Lane roundabout. Load moves away from camera. Negotiable in contraflow under police escort.

Photograph 22

B1508 Bures Road. Load moves away from camera. Caution parked cars. Parking restrictions would be advisable.

Photograph 23

B1508 Bures Road/Grantham Avenue roundabout. Load moves away from camera. Negotiable in contraflow under police escort.

Photograph 24

B1508 Bures Road. Load moves away from camera. Full occupation of the carriageway. Tree pruning may be necessary depending on growth at the time of movement.

Photograph 25

B1508 Bures Road. Load moves away from camera. Full occupation of the carriageway. Tree pruning may be necessary depending on growth at the time of movement. Caution with overhead wires.

Photograph 26

B1508 Bures Road. Load moves away from camera. Full occupation of the carriageway. Caution with overhead wires.

Photograph 27

B1508 Bures Road. Load moves away from camera. Full occupation of the carriageway. Caution with overhead wires.

Photograph 28

B1508 Bures Road. Load moves away from camera. Full occupation of the carriageway. Tree pruning may be necessary depending on growth at the time of movement.

Photograph 29

B1508 Bures Road. Load moves away from camera. Full occupation of the carriageway. Caution with overhead wires.

Photograph 30

B1508 Bures Road. Load moves away from camera. Full occupation of the carriageway. Tree pruning may be necessary depending on growth at the time of movement.

Photograph 31

B1508 Bures Road. Load moves away from camera. Full occupation of the carriageway. Caution with overhead wires. This is the approximate site access point where new access road will be created to the east. No issues with access expected as long as site access is designed to be considerate of loaded trailer arrangements.

7.4. *Access Point Stour Valley West.*

7.4.1. Access from the M11 via the A120 to the A131 is negotiable and as far as Braintree is proven for 16 axle trailers transporting SGTs to Braintree Substation. The final approach from the A120/131 junction to site is described below.

Photograph 32

A131/B1053 roundabout north of Braintree. Load approaches from left and exits behind camera. Negotiable.

7.4.2. The A131 from Braintree to Halstead is considered negotiable for the proposed loads. However, as with the other routes discussed in this report, there will be a need for the appointed haulage contractor to agree exact escort and traffic management requirements with the police as there will be sections of the A131 where the AIL will require to utilise the full width of the carriageway including crossing over solid white lines. In this case the route will be solely within Essex police's jurisdiction. There are also areas where tree pruning may be necessary depending on growth at the time of movement. Example photographs of typical locations are shown below.

Photograph 33

A131 north of Braintree. Load moves away from camera. Possible layup area to relive traffic congestion.

Photograph 34

A131 north of Braintree at High Garrett. Load moves away from camera. Caution with street furniture required but considered negotiable.

Photograph 35

A131 north of Braintree at High Garrett. Load moves away from camera. Caution with street furniture required but consider negotiable. Caution also with overhead wires.

Photograph 36

A131/A1071 junction. Load moves away from camera bearing right. Negotiable.

Photograph 37

A131/A1071 junction. Load moves away from camera bearing right. Negotiable.

Photograph 38

A131 south of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management.

Photograph 39

A131 south of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 40

A131 south of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 41

A131 south of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 42

A131 south of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 43

A131 south of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 44

A131 south of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 45

A131 south of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 46

A131 south of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 47

A131 south of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 48

A131 south of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 49

A131 on approach to Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Caution required with street furniture.

Photograph 50

A131 on approach to Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Caution required with street furniture.

Photograph 51
A131 on approach to Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Caution required with street furniture.

Photograph 52
A131 in Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Caution with overhead wires needed on entire route but not a significant restriction.

Photograph 53
A131 Trinity Street/Bridge Street right bend in Halstead. Vehicle moves away from camera. Negotiable for cable drum loads with full occupation of the carriageway.

Photograph 54

A131 Bridge Street/High Street left bend in Halstead approaching Town Bridge. Vehicle moves away from camera. Negotiable for cable drum loads with full occupation of the carriageway.

Photograph 55

A131 Town Bridge. Vehicle moves away from camera. Negotiable for cable drum loads. Note that this is the significant structural limitations on the A131 at present that remains under assessment for SGT AIL loads.

Photograph 56

A131 Halstead High Street. Vehicle moves away from camera. Negotiable for cable drum loads. Consideration of traffic management required in consultation with Essex Police.

Photograph 57

A131 Halstead High Street. Vehicle moves away from camera. Negotiable for cable drum loads. Consideration of traffic management required in consultation with Essex Police.

Photograph 58

A131 north of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 59

A131 north of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 60

A131 north of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required. Caution with overhead wires.

Photograph 61

A131 north of Halstead. Vehicle moves away from camera. Negotiable for cable drum loads. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

7.4.3. This A131 then continues to the new proposed site access location that is to be developed by National Grid. No issues with access expected as long as site access is designed to be considerate of loaded trailer arrangements.

8. Summary and Conclusions

8.1. A selection of sites have been considered in terms of their suitability for AIL delivery of cable drum components.

8.2. As the loads are able to be transported at STGO they will not necessarily need to be delivered to the nearest port although it is expected that an east coast port would be a potential delivery location subject to route approval at the time of requirement. It was assumed at the commencement of investigations that this will be feasible without difficulty for the loads.

8.3. The trailer arrangement provided to the structural authorities for consideration in this investigation has been produced to be considerate and representative of those available in the UK heavy haulage market in terms of their suitability on the potential access route from the A12 and A14 to site.

8.4. It should be noted that the transport drawing number 21-1030.TC01 is an assumed worst case in terms of physical negotiability requirements due to an outside track (bogie width) of 3.0 m being proposed. It is anticipated that it will also be possible to procure transport arrangements with reduced width of trailer bogies. The trailer arrangement drawing has been produced to be considerate and representative of those available in the UK heavy haulage market in terms of their suitability on the potential access route from the A12 and A14 to site. This does have relatively high axle loads of 16.5te on the 2 rear tractor axles.

8.5. An alternative in the event that axles loads prove an issue in terms of structural clearance is to add 2 axles to the trailer arrangement below the neck of the trailer to reduce loadings (drawing number 21-1030.TC07. However, this will increase the length of a delivery vehicle. It would be advisable for this larger arrangement to be considered in initial site access considerations as it is more onerous in terms of physical negotiability requirements.

8.6. Whilst there are no major limitations to access on the A12 and A14 it is recommended that dialogue is maintained with National Highways East at a strategic level to keep them advised of the overall scheme developments and timescales in order that there will be minimal disruption on the trunk road network and so that the weight limitations on the A12 and A14 can be managed and the final cable drum weights will need to be considerate of the weight limitations advised on A12 and A14 so that they can either be adhered to or avoided by the highlighted diversions.

8.7. SCC have advised that the preferred routes identified are structurally suitable for the proposed AILs at this moment in time. Alternative routes to the three easterly locations are limited to some extent by structures but as these can be avoided, they have not been explored further in terms of remedial works.

8.8. ECC have advised that for access to Stour Valley West, located off the A131 between Sudbury and Halstead the loads are not presently able to use the A131 Town Bridge at Halstead as this has a 44te gross vehicle weight capacity. This is currently being assessed for the much heavier (178te nett) Super Grid Transformer (SGT) loads and will be discussed further in the report to be issued under separate cover, but in 2009 the structure was assessed as acceptable for transformer loads based on a nett transport weight of 137te and in 2012 was reconfirmed by ECC as acceptable for trailers carrying a 169.7te nett transformer. Alternative diversion routes have been discussed with ECC that would avoid Town Bridge, but none have been identified as suitable for cable drums at this time.

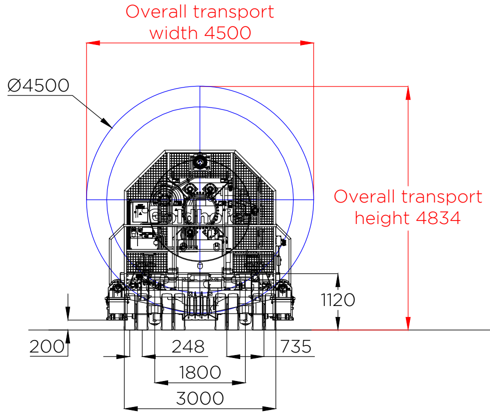
8.9. There are various options for routes to all the sites, but the preferred routes are as detailed within this report. The exact route used will be determined at the time of movement by the appointed haulage contractor upon final confirmation of the exact cable drum dimensions and associated road transport delivery vehicle. However, generally AIL access for the current worst case load is considered feasible to each of the site access locations via the preferred route. Although a recommended route to each of the sites is provided, this is not final and is suggested as an appropriate AIL route to site based on present considerations and the investigative works. As stated, final route selections will be determined closer to the time of movement but the agreed routes confirm that in principle access is feasible.

8.10. The route investigations detailed are a view of the current status of the proposed heavy load route options only and do not consider any other components or traffic to the site.

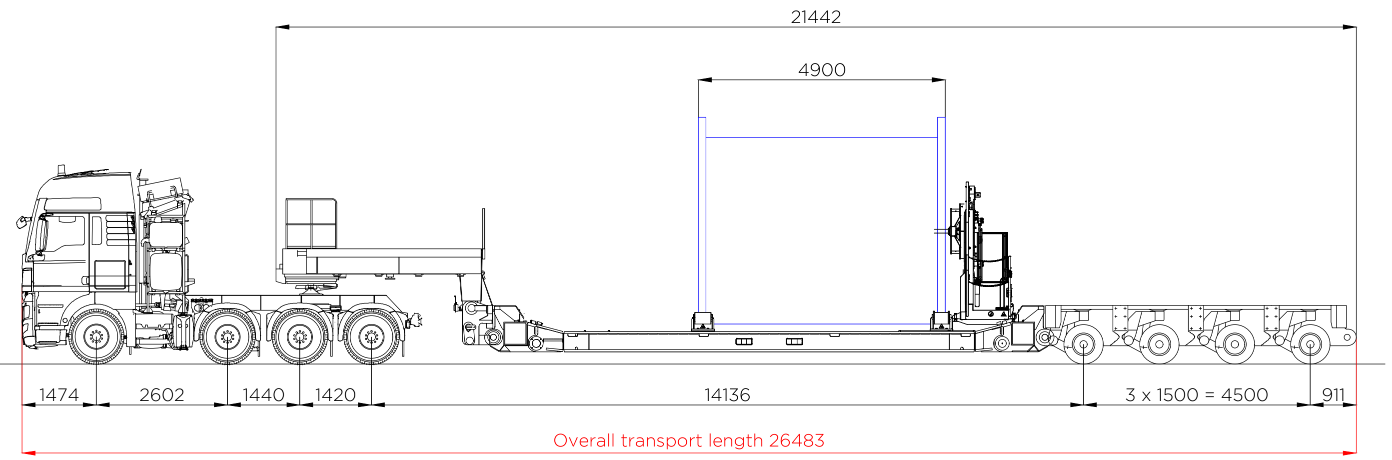
8.11. The report is intended to be a summary of the AIL route access at the current time and is not a guarantee that the route will be cleared in the future. Specific movements will need to be assessed at the time on an individual basis. If any further information is required, it is available on request.

Appendix 1

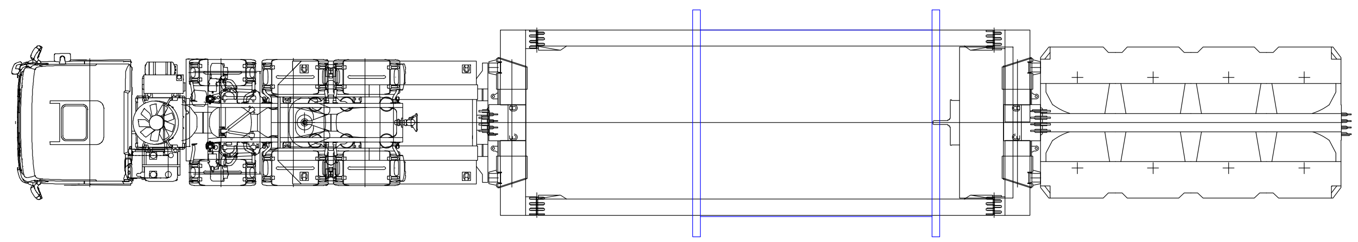
Transport Configurations



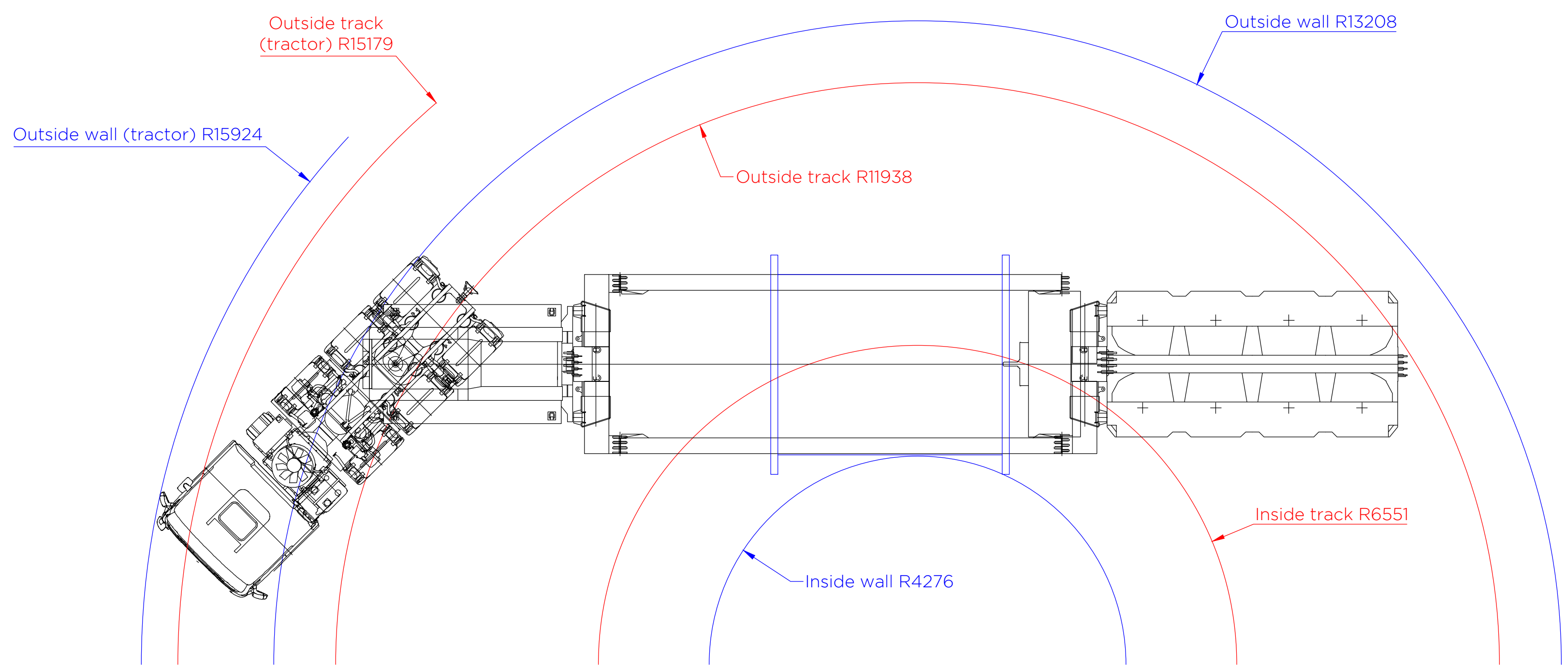
Profile view



Elevation view - 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum



Plan view - 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum



Minimum turning radii information
4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum

Load table

4 axle modular reeling trailer

Self weight of cable drum	60.0 te
Self weight of trailer	33.3 te
Self weight of tractor	15.0 te
Total combined weight	108.3 te
Load per axle line (trailer)	14.72 te
Load per axle	7.36 te
Load per wheel (4 per axle)	1.84 te
Overall ground bearing pressure	3.27 te/m²

Tractor (15 te)

Front axle	6.4 te
Second steer	10.0 te
Rear axle	16.5 te
Rear axle	16.5 te

Notes:
[1] The figures shown above are representative of the transport configuration portrayed. However as tractor and trailer arrangements vary then the loads and dimensions indicated should be treated as probable values.

[2] Actual dimensions, including axle spacing and mean running height, may vary slightly depending on manufacturer of trailer deployed.

[3] All linear measures in millimetres unless stated otherwise.

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Revisions

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Project:

Bramford to Twinstead

Title:

Indicative transport configuration
Indicative 60.0 te cable drum carried on
4 axle modular reeling trailer
showing minimum turning radii

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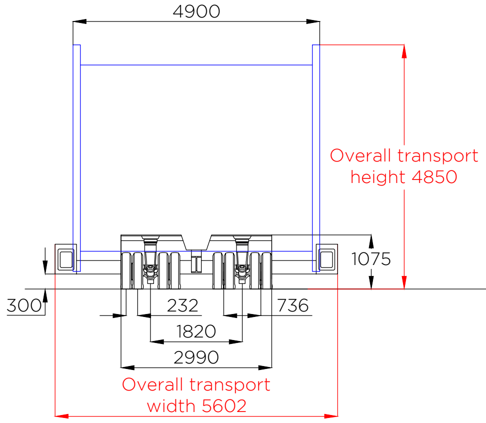
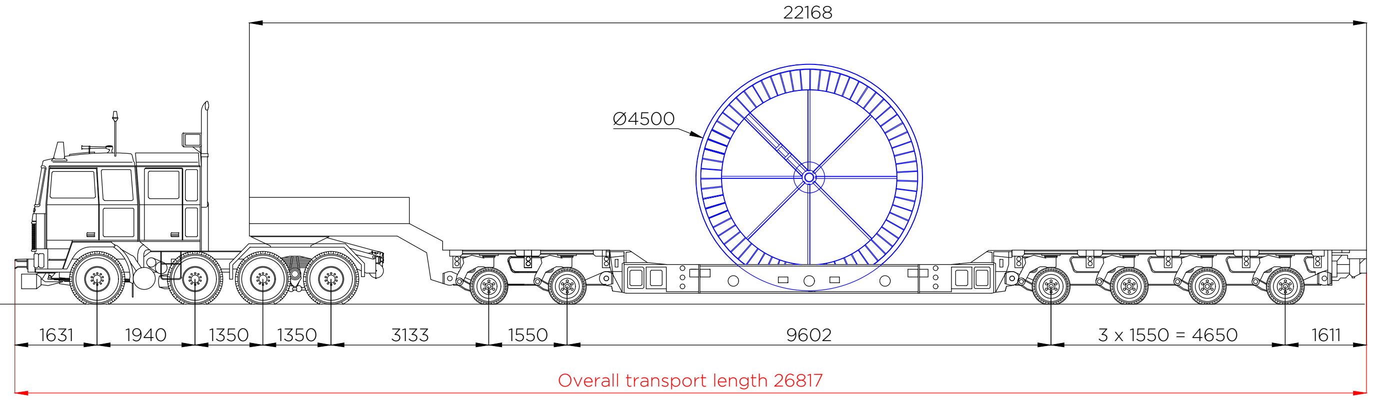
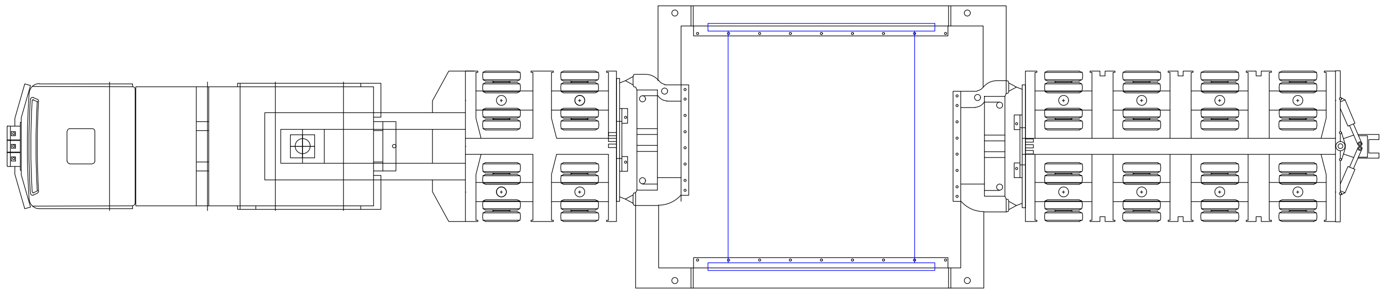


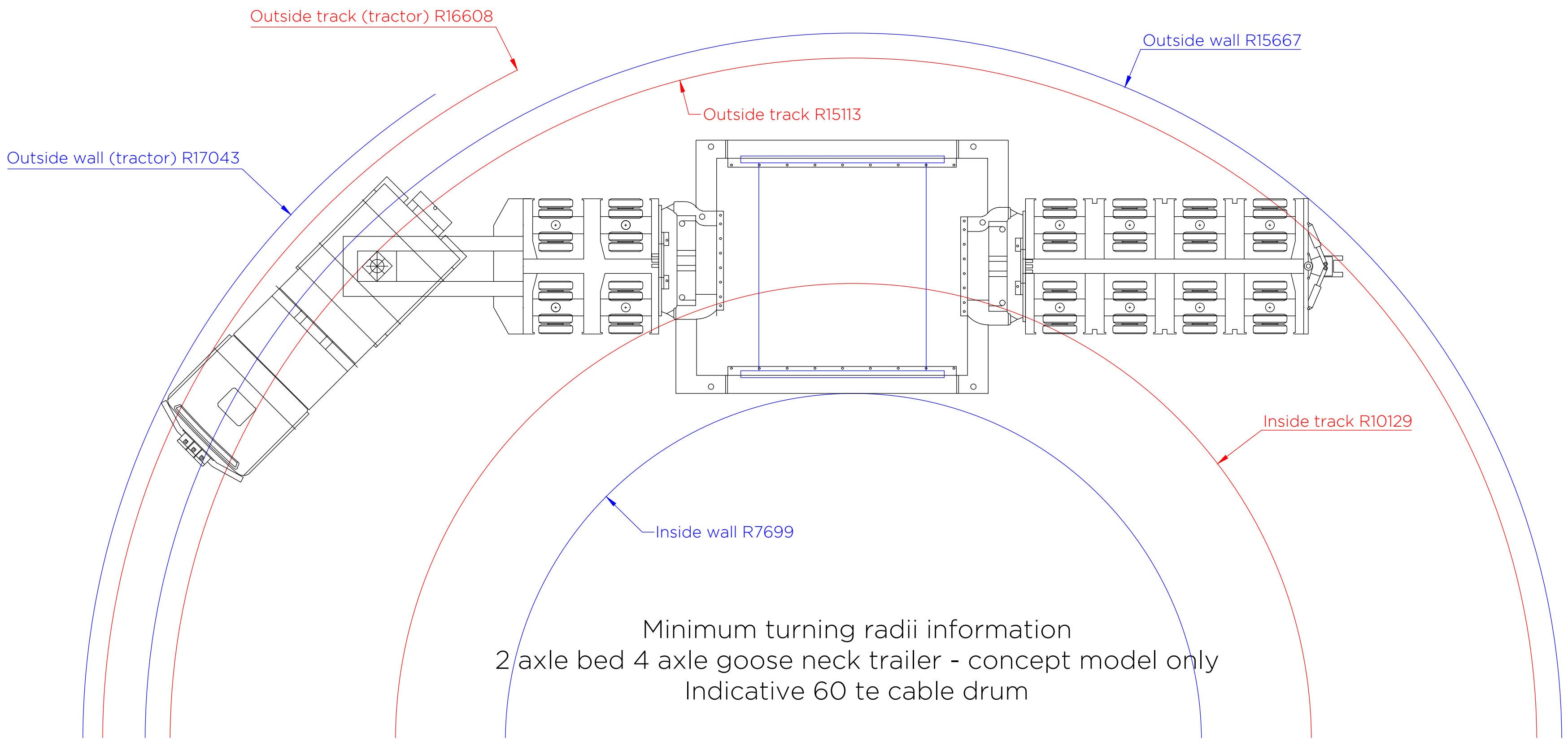
Profile view



Elevation view - 2 axle bed 4 axle goose neck trailer - concept model only
Indicative 60 te cable drum



Plan view - 2 axle bed 4 axle goose neck trailer - concept model only
Indicative 60 te cable drum



Minimum turning radii information
2 axle bed 4 axle goose neck trailer - concept model only
Indicative 60 te cable drum

Load table	
2 axle bed 4 axle goose neck trailer	
Self weight of cable drum	60.0 te
Self weight of trailer	43.0 te
Self weight of tractor	14.0 te
Total combined weight	117.0 te
Max. load per axle line (2 axle section)	13.39 te
Load per axle	6.70 te
Load per wheel (4 per axle)	1.67 te
Max. overall ground bearing pressure	5.78 te/m²
Tractor(s) (14 te)	
Front axle	5.0 te
Second steer	7.0 te
Rear axle	12.3 te
Rear axle	12.3 te

Notes:
[1] The figures shown above are representative of the transport configuration portrayed. However as tractor and trailer arrangements vary then the loads and dimensions indicated should be treated as probable values.

[2] Actual dimensions, including axle spacing and mean running height, may vary slightly depending on manufacturer of trailer deployed.

[3] All linear measures in millimetres unless stated otherwise.

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Project:

Bramford to Twinstead

Title:

Indicative transport configuration
Indicative 60.0 te cable drum carried on 2 axle bed 4 axle goose neck trailer showing minimum turning radii

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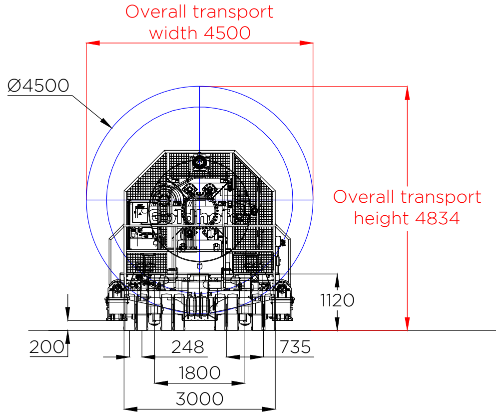

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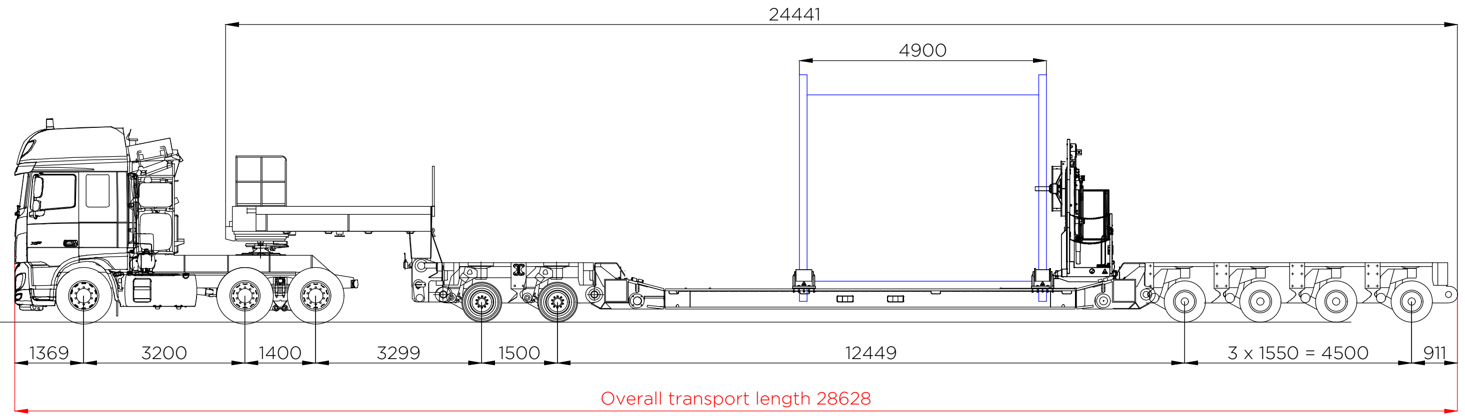
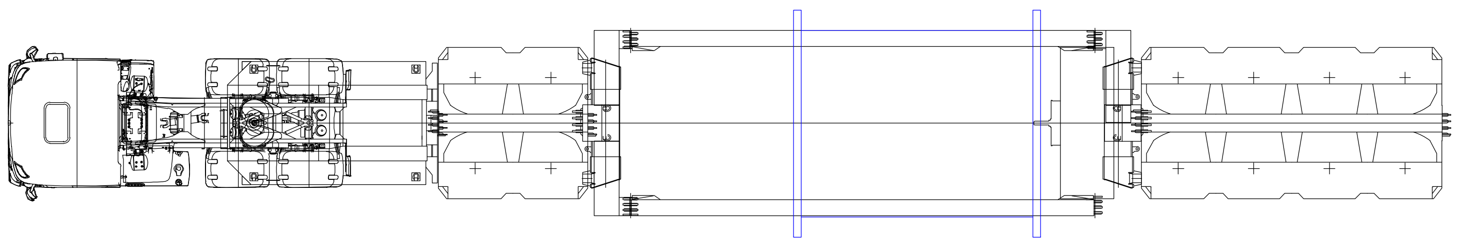
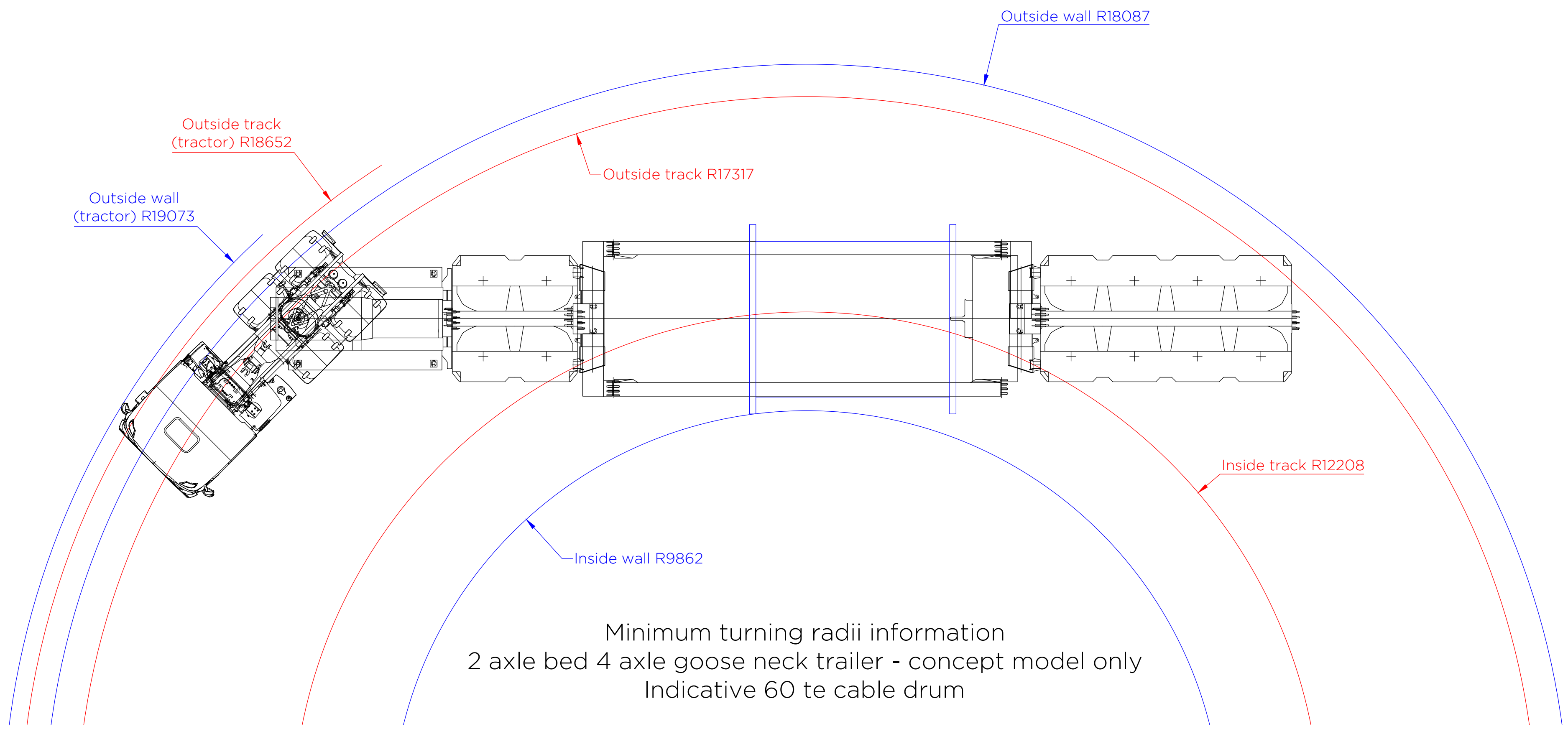


Elevation view - 2 axle bed 4 axle goose neck trailer - concept model only
Indicative 60 te cable drum



Plan view - 2 axle bed 4 axle goose neck trailer - concept model only
Indicative 60 te cable drum



Minimum turning radii information
2 axle bed 4 axle goose neck trailer - concept model only
Indicative 60 te cable drum

Load table

2 axle bed 4 axle goose neck trailer	
Self weight of cable drum	60.0 te
Self weight of trailer	39.6 te
Self weight of tractor	12.0 te
Total combined weight	111.6 te
Max. load per axle line (4 axle section)	14.12 te
Load per axle	7.06 te
Load per wheel (4 per axle)	1.77 te
Max. overall ground bearing pressure	3.14 te/m²

Tractor (12 te)	
Front axle	8.2 te
Second steer	12.7 te
Rear axle	12.7 te

Notes:

[1] The figures shown above are representative of the transport configuration portrayed. However as tractor and trailer arrangements vary then the loads and dimensions indicated should be treated as probable values.

[2] Actual dimensions, including axle spacing and mean running height, may vary slightly depending on manufacturer of trailer deployed.

[3] All linear measures in millimetres unless stated otherwise.

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Title:

Indicative transport configuration
Indicative 60.0 te cable drum carried on
2 axle bed 4 axle goose neck trailer
showing minimum turning radii

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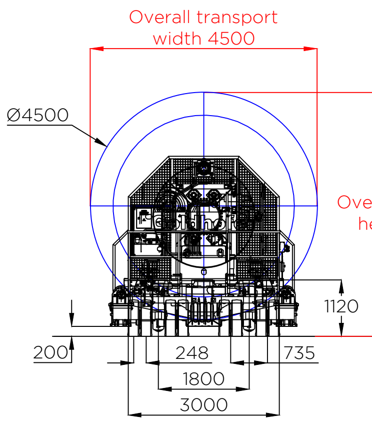

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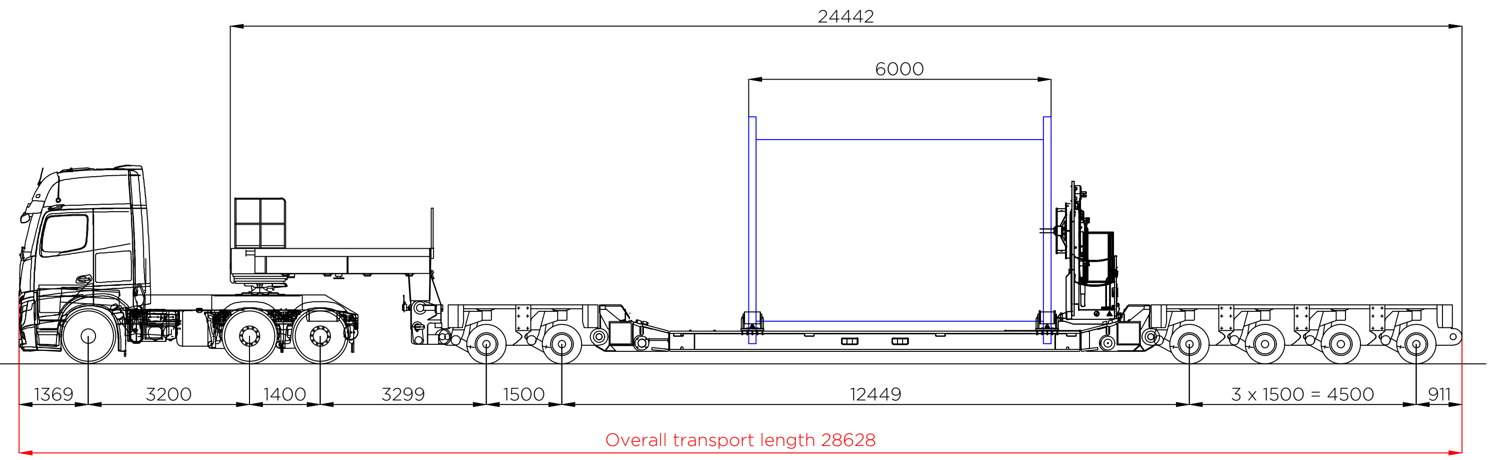
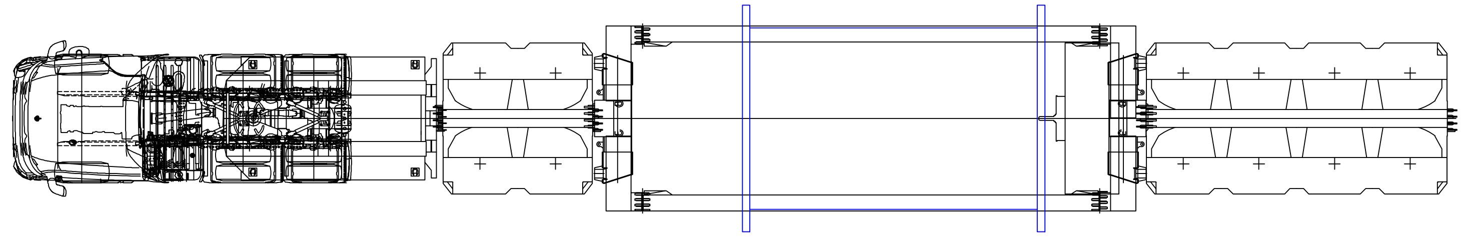
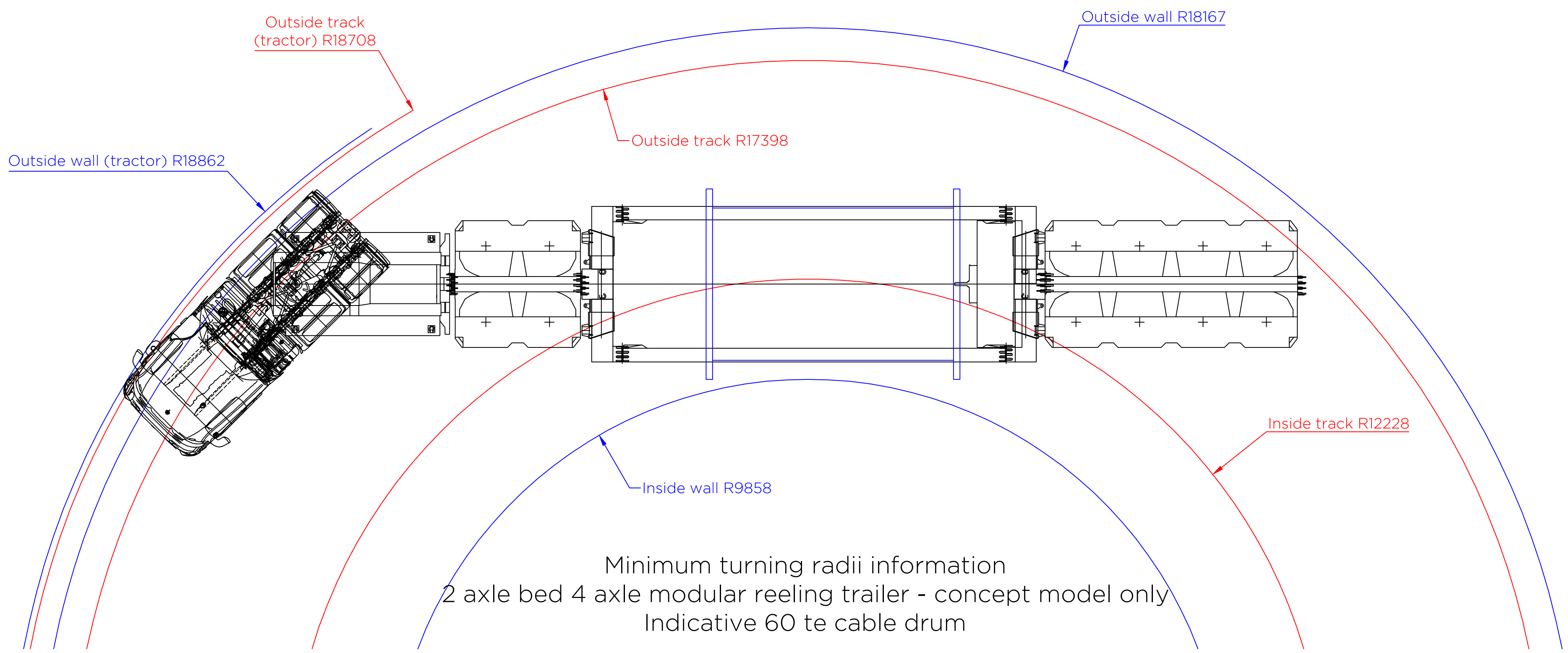


Elevation view - 2 axle bed 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum



Plan view - 2 axle bed 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum



Minimum turning radii information
2 axle bed 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum

Load table

4 axle modular reeling trailer

Self weight of cable drum	60.0 te
Self weight of trailer	39.6 te
Self weight of tractor	12.0 te
Total combined weight	111.6 te
Max. load per axle line (trailer)	14.12 te
Load per axle	7.06 te
Load per wheel (4 per axle)	1.77 te
Max. overall ground bearing pressure (trailer)	4.77 te/m²

Tractor (12 te)

Front steer	8.1 te
Rear axle	12.7 te
Rear axle	12.7 te

Notes:

[1] The figures shown above are representative of the transport configuration portrayed. However, as tractor and trailer arrangements vary then the loads and dimensions indicated should be treated as probable values.

[2] Actual dimensions, including axle spacing and mean running height, may vary slightly depending on manufacturer of trailer deployed.

[3] All linear measures in millimetres unless stated otherwise.

[4] Minimum turning radii based upon maximum steering angle of 45 degrees. Some trailers operate to a maximum steering angle of 60 degrees, which will improve negotiability.

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Bramford to Twinstead

Title:

Indicative transport configuration
Indicative 60.0 te cable drum carried on
2 axle bed 4 axle modular reeling trailer
showing minimum turning radii

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Final report

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21-1030.TC07	1 of 1	0

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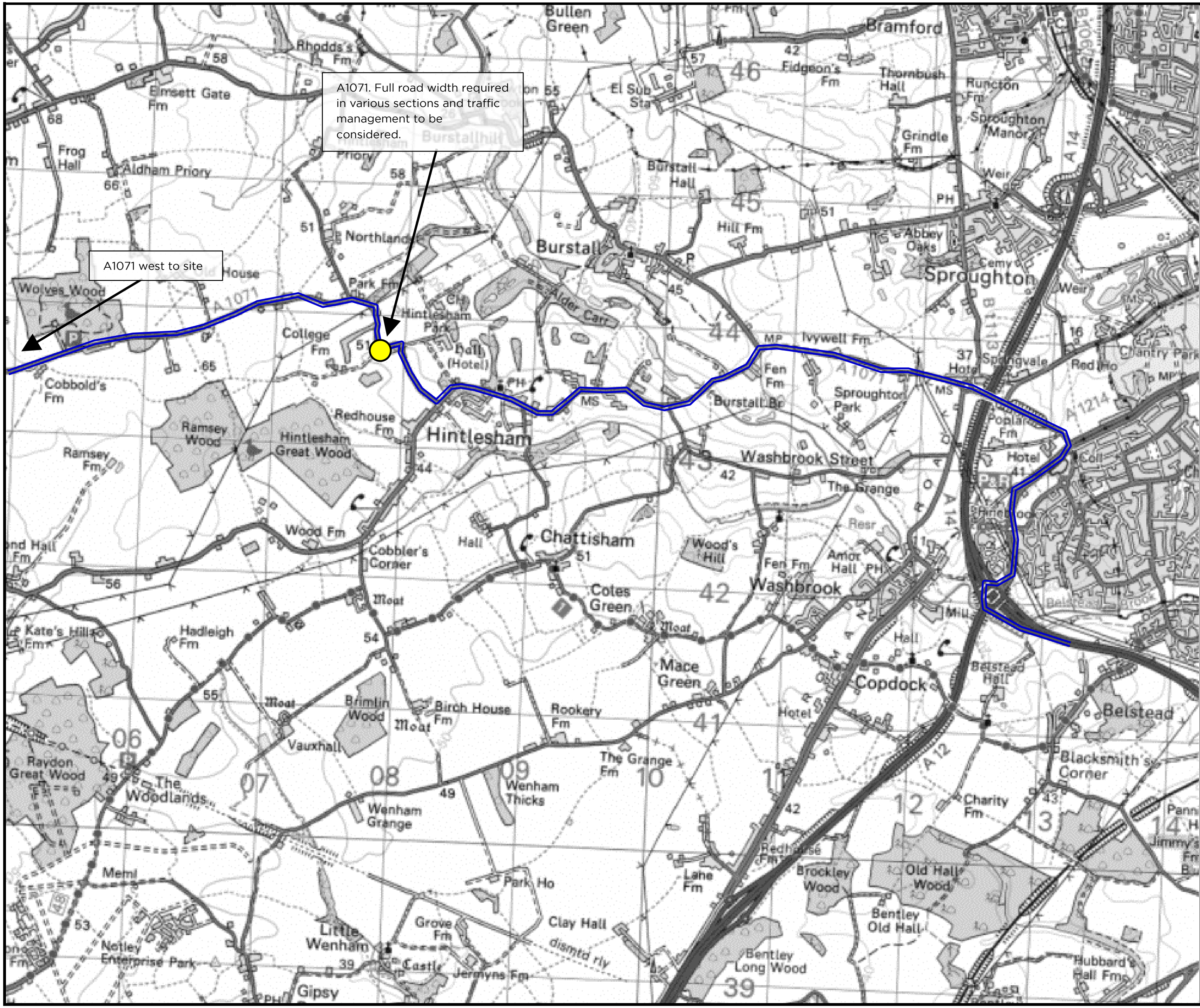
Appendix 2

Maps



Key

(blue line)	Proposed Route to Access Point AONB East – Quarry from A12/A14
(yellow circle)	Point of Interest
(red circle)	Access Point AONB East - Quarry

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B		
A		
0	06.07.22	First Issue

Revisions

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Project:

21-1030 Bramford to Twinstead

Title:

Map 1 – Route to AONB East - Quarry

Drawing Status:

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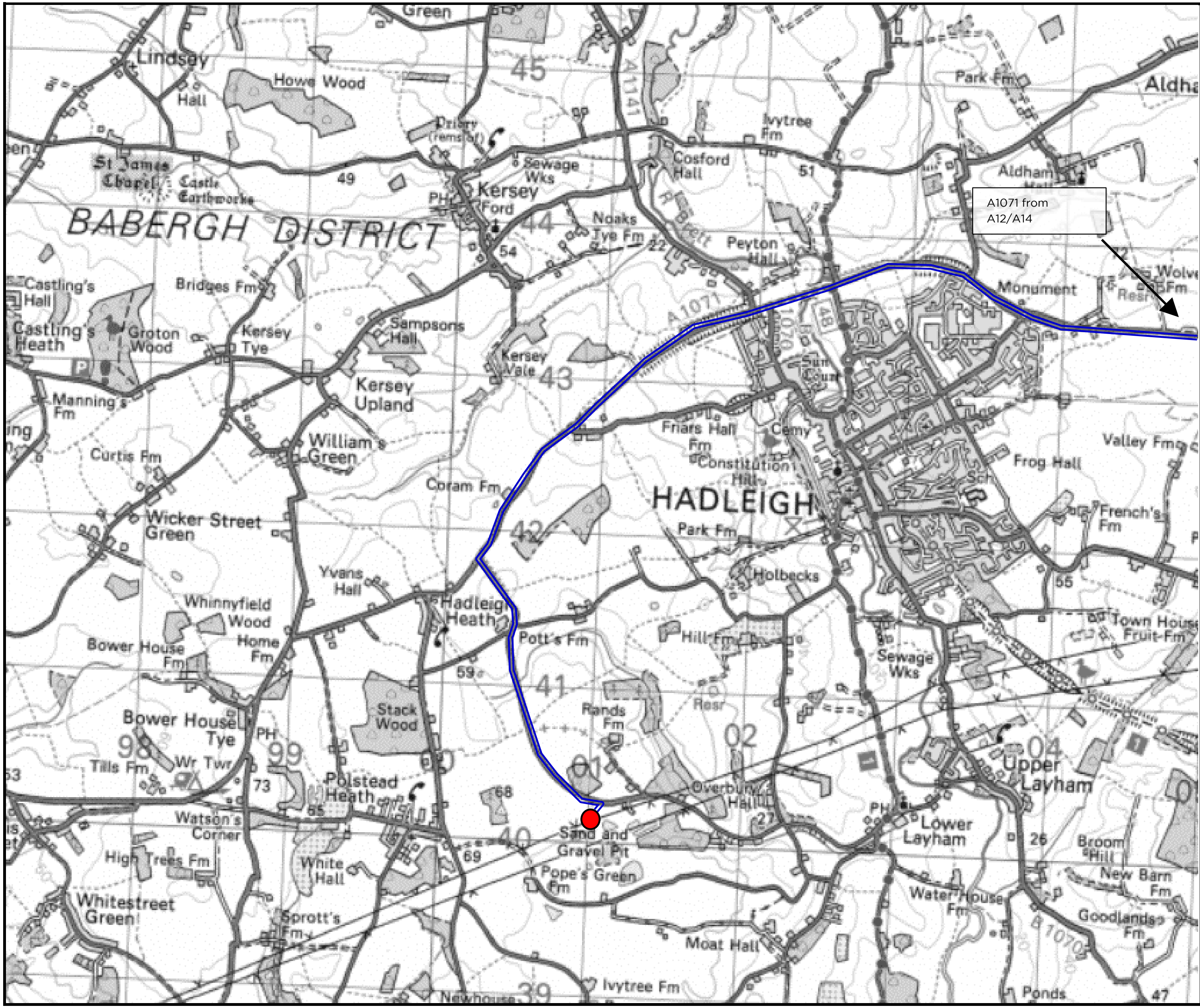
NTS	HW	ARP

Ref No.:	Sheet:	Rev.:
21-1030	1 of 2	0



Key

(blue double line)	Proposed Route to Access Point AONB East – Quarry from A12/A14
(yellow circle)	Point of Interest
(red circle)	Access Point AONB East - Quarry

Rev	Date	Amendments:
B		
A		
0	06.07.22	First Issue

Revisions

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Project:

21-1030 Bramford to Twinstead

Title:

Map 1 – Route to AONB East - Quarry

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Final Report

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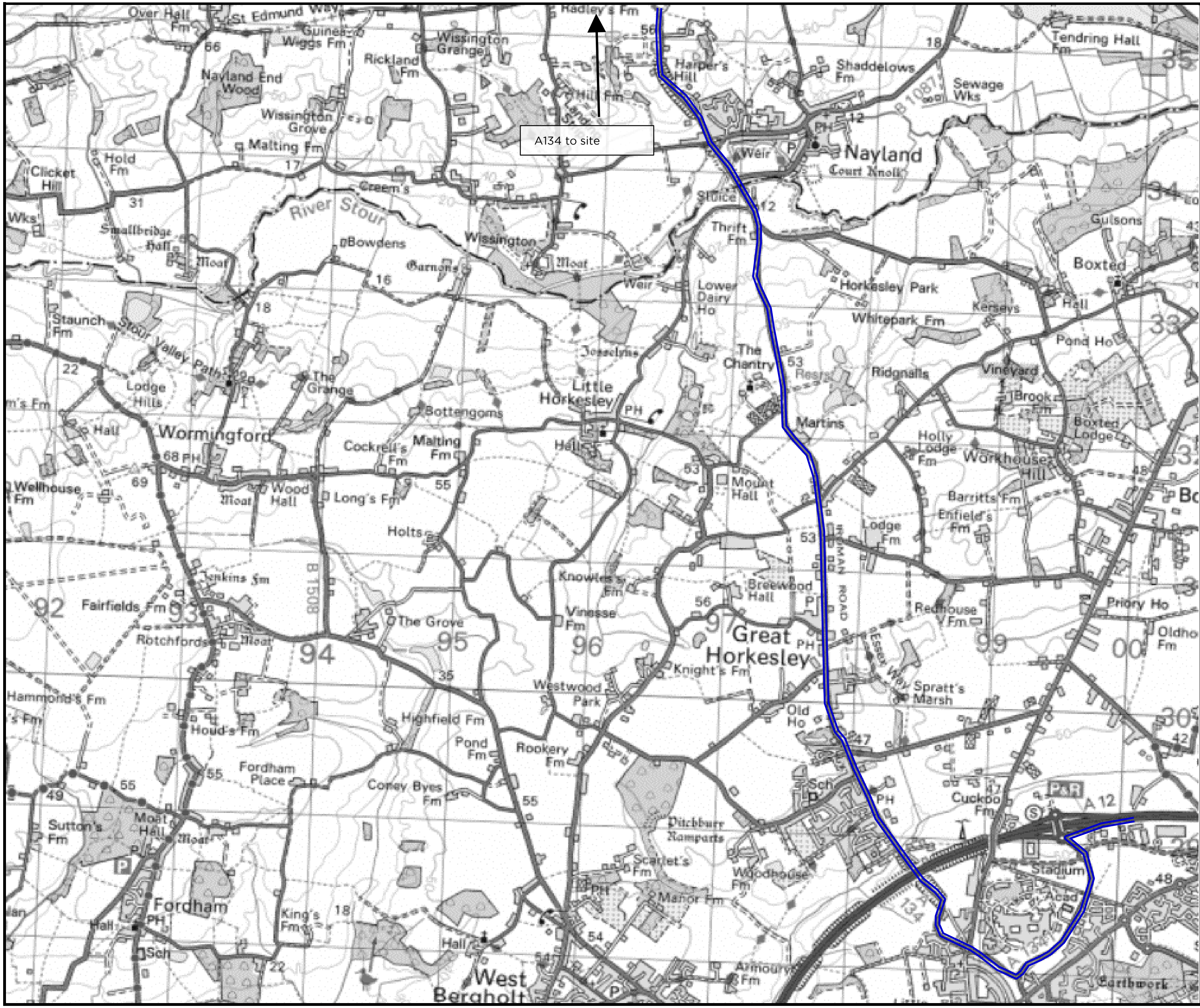
NTS	HW	ARP

Ref No.:	Sheet:	Rev.:
21-1030	2 of 2	0



Key

(blue double line)	Proposed Route to
(yellow circle)	Point of Interest
(red circle)	Access Point ANOB West A134
(purple circle)	Access Point Workhouse Green

B		
A		
0	06.07.22	First Issue
Rev	Date	Amendments:

Revisions

Wynns Ltd.
Independent Transportation Engineers

Shaftesbury House, 2 High Street, Eccleshall, Stafford, ST21 6BZ. Tel: (01785) 850411

Client: nationalgrid

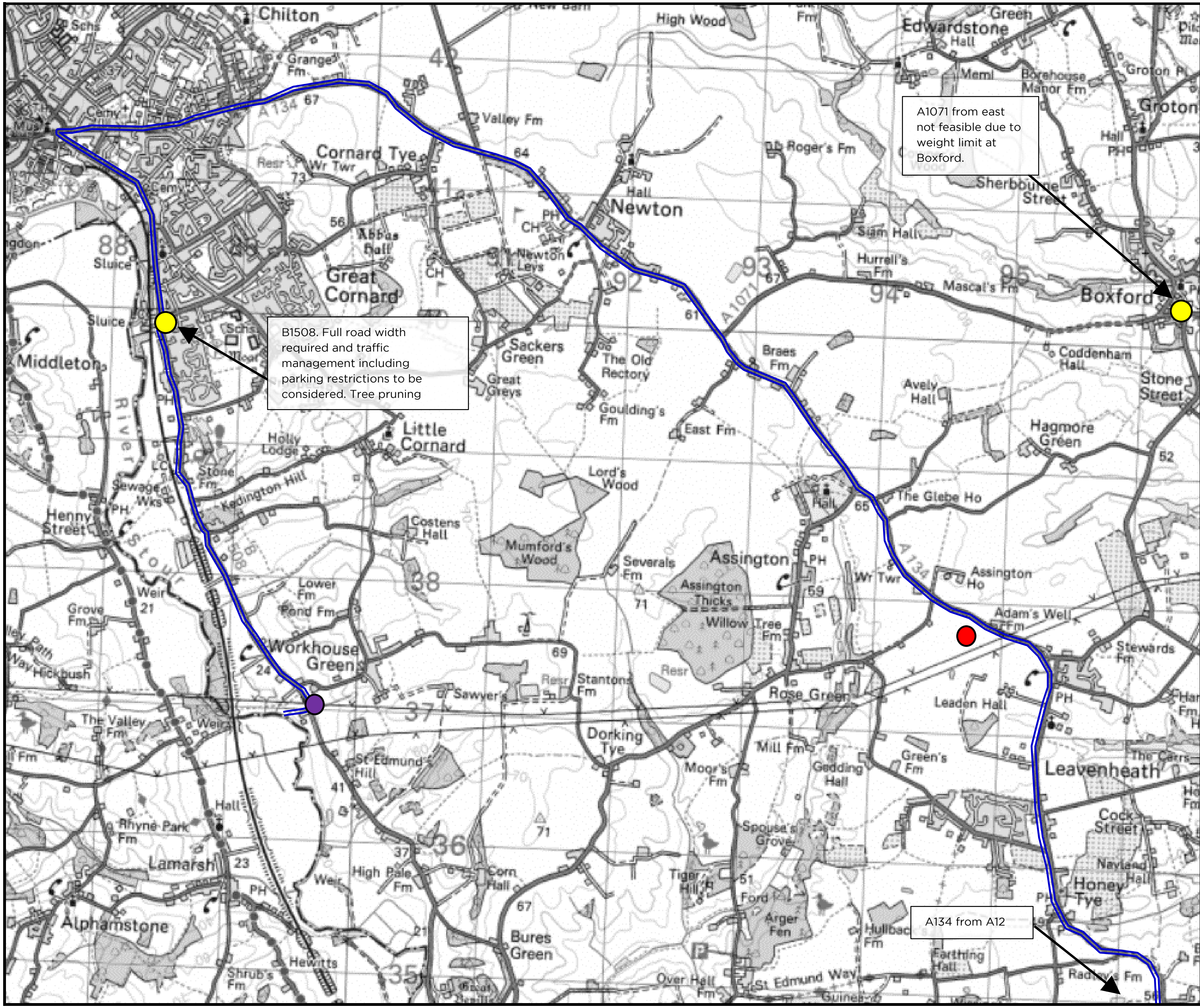
Project: 21-1030 Bramford to Twinstead

Title: Map 2– Route to ANOB West A134 & Stour Valley East Workhouse Green

Drawing Status: Final Report

Scale (A4):	Drawn by:	Checked by:
NTS	HW	ARP

Ref No.:	Sheet:	Rev.:
21-1030	1 of 2	0



Key

Blue line	Proposed Route to
Yellow circle	Point of Interest
Red circle	Access Point ANOB West A134
Purple circle	Access Point Workhouse Green

Rev	Date	Amendments:
B		
A		
0	06.07.22	First Issue

Revisions

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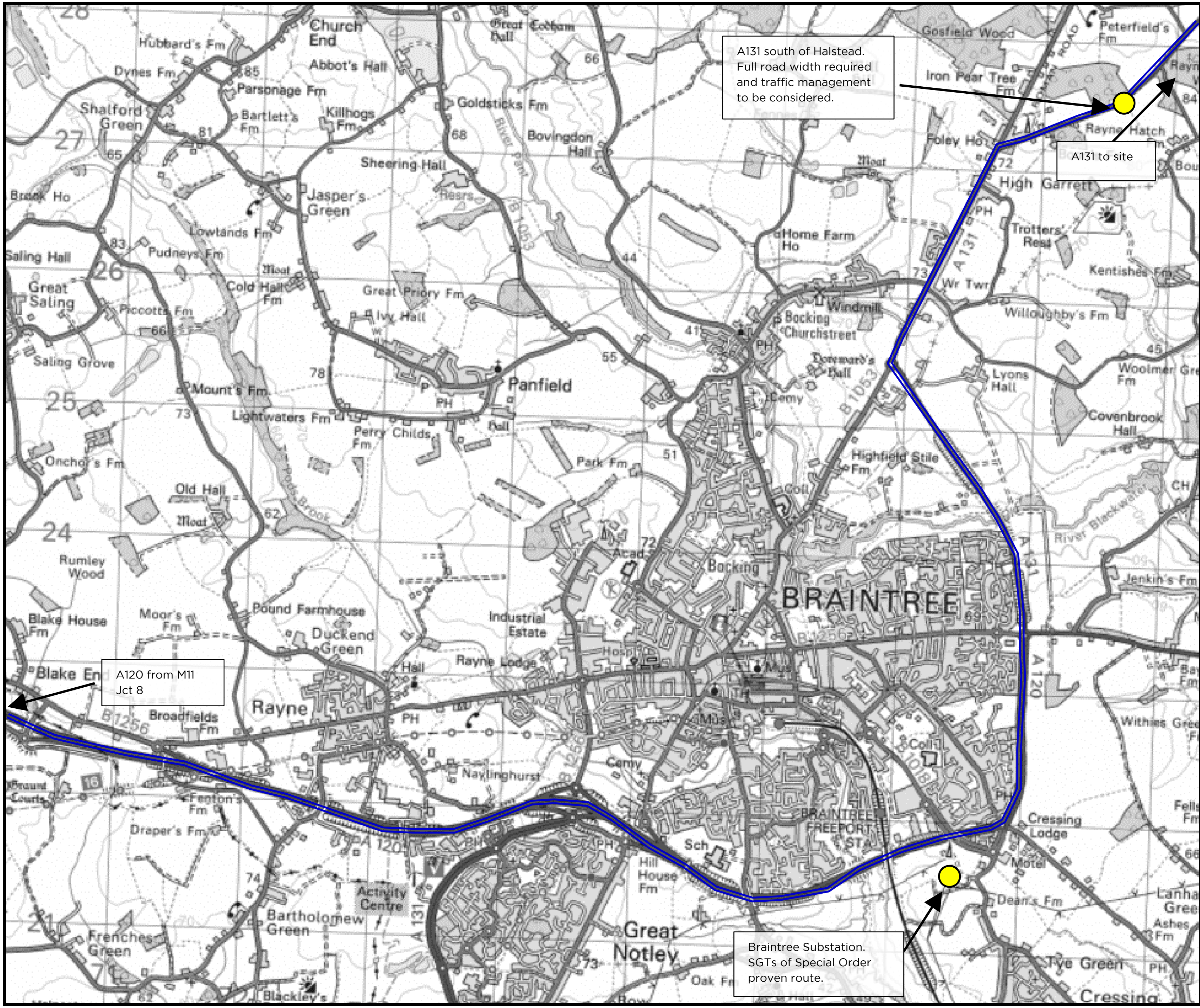
Scale (A4):	Drawn by:	Checked by:
NTS	HW	ARP

Ref No.:	Sheet:	Rev.:
21-1030	2 of 2	0



Key

Blue line	Proposed Route to Stour Valley West
Yellow circle	Point of Interest
Red circle	Access Point Stour Valley West

Rev	Date	Amendments:
B		
A		
0	06.07.22	First Issue

Revisions

Wynns Ltd.
Independent Transportation Engineers

Shaftesbury House, 2 High Street, Eccleshall, Stafford, ST21 6BZ. Tel: (01785) 850411

Client: nationalgrid

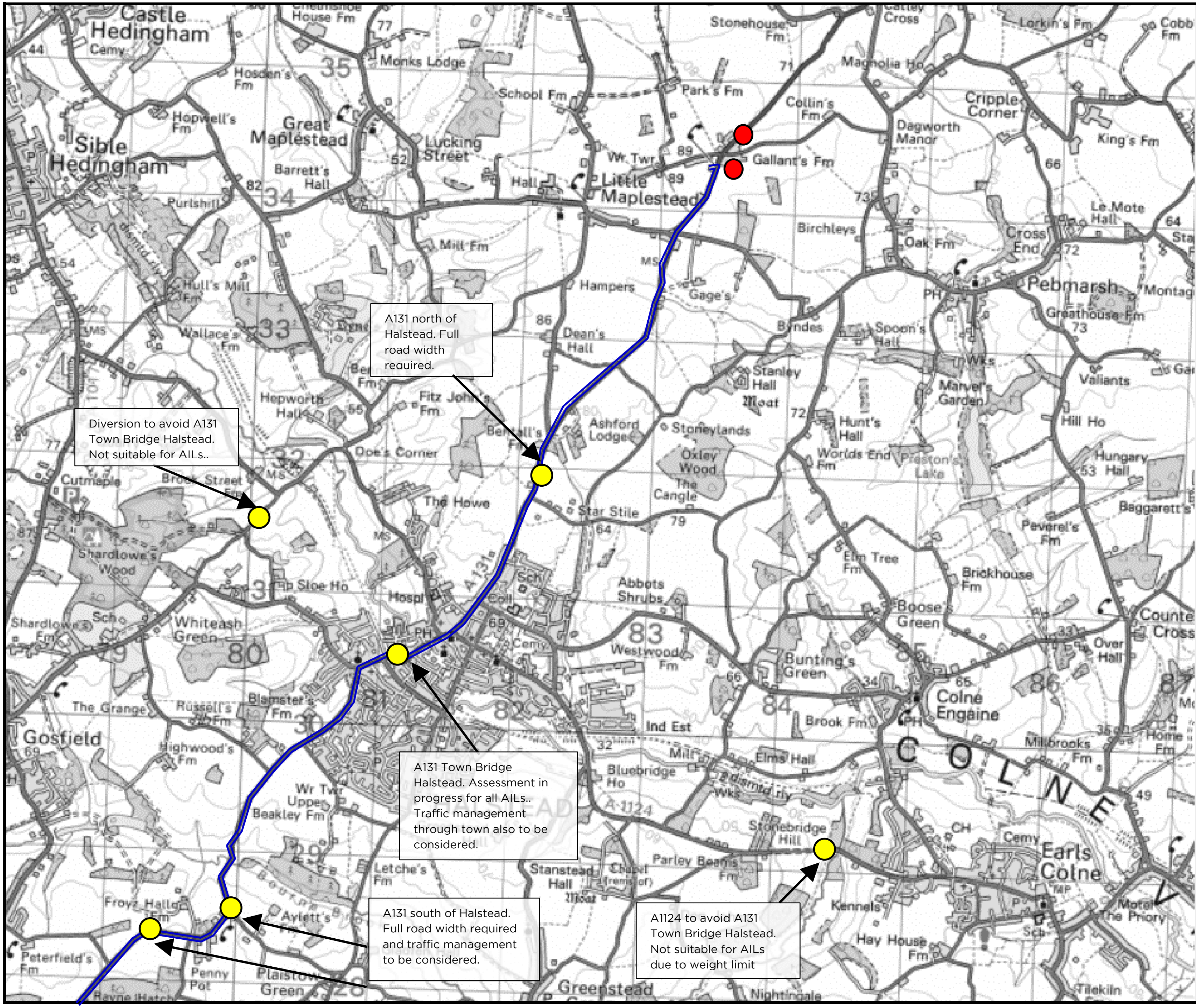
Project: 21-1030 Bramford to Twinstead

Title: Map 3 – Route to Stour Valley West

Drawing Status: Final Report

Scale (A4):	Drawn by:	Checked by:
NTS	HW	ARP

Ref No.:	Sheet:	Rev.:
21-1030	1 of 2	0



Key

(blue double line)	Proposed Route to Stour Valley West
(yellow circle)	Point of Interest
(red circle)	Access Point Stour Valley West

Rev	Date	Amendments:
B		
A		
0	06.07.22	First Issue

Revisions

Wynns Ltd. Independent Transportation Engineers

Shaftesbury House, 2 High Street, Eccleshall, Stafford, ST21 6BZ. Tel: (01785) 850411

Client: nationalgrid

Project: 21-1030 Bramford to Twinstead

Title: Map 3 – Route to Stour Valley West

Drawing Status: Final Report

Scale (A4):	Drawn by:	Checked by:
NTS	HW	ARP

Ref No.:	Sheet:	Rev.:
21-1030	2 of 2	0

Appendix 3

National Highways Aide Memoir

highways england

Aide Memoire for notification requirements for the movement of Abnormal Indivisible Loads or vehicles by road when not complying with The Road Vehicles (Construction and Use) Regulations 1986 (commonly known as C & U)

Weight

Gross weight of vehicle carrying the load exceeding C & U limits up to 80,000kgs (78.74 tons)	2 clear days notice with indemnity to Road and Bridge Authorities.
Gross weight of vehicle carrying the load exceeding 80,000kgs up to 150,000kgs (147.63 tons)	2 clear days notice to Police and 5 clear days with indemnity to Road and Bridge Authorities.
Gross weight of vehicle carrying the load exceeding 150,000kgs (147.63 tons)	Highways England Special Order* plus 5 clear days notice to Police and 5 clear days notice with indemnity to Road and Bridge Authorities

Width

C & U loads:- width exceeding 2.9m (9ft 6ins) up to 4.3m (14ft 1 ins) STGO loads:- width exceeding 3.0m (9ft 10ins) up to 5.0m (16ft 5ins)	2 clear days notice to Police
Width exceeding 5.0m (16ft 5ins) up to 6.1m (20ft)	Highways England form VR1** plus 2 clear days notice to Police
Width exceeding 6.1m (20ft)	Highways England Special Order* plus 5 clear days notice to Police and 5 clear days notice with indemnity to Road and Bridge Authorities

Length

C&U loads:- length exceeding 18.65m (61ft 2in) up to 27.4m (90ft) - See C&U Regulations 1986 for definition of length STGO loads:- length exceeding 18.75m (61ft 6 ins) - See part 2, article 12 of the Road Vehicles (Authorisation of Special Types) (General) Order 2003 (Commonly known as STGO) for definition of length	2 clear days notice to Police
Overall length of a part 2 vehicle-combination exceeding 25.9m (85ft)	2 clear days notice to Police
Maximum length exceeding 30.0m (98ft 5ins) – see STGO Schedule 1, part 4, paragraph 25 for definition of maximum length NB For some very light loads, such as yacht masts, that are moved on conventional motor vehicles not exceeding 12 tonnes gross weight or trailers not exceeding 10 tonnes gross weight, a Highways England Special Order* will be required if the rigid length exceeds 27.4m (89ft 11ins)	Highways England Special Order* plus 5 clear days notice to Police and 5 clear days notice with indemnity to Road and Bridge Authorities.

NOTE 1 “Clear days Notice” excludes Saturdays, Sundays or a public holiday in any part of Great Britain in relation to movements authorised by the Special Types General Order only, there being no such exclusion in Special Orders unless specifically stated.

NOTE 2 There is no statutory limit governing the overall height of a load, however, when applying for a Special Order or VR1 it should, wherever possible, not exceed 4.95m (16ft 3ins) in order that the maximum use can be made of the motorway and trunk road network.

NOTE 3 The notification requirements for mobile cranes can be found in the Road Vehicles (Authorisation of Special Types) (General) Order 2003, statutory instrument number 1998 (Part 2 Articles 10 to 18), which is available on the OPSI website: http://www.legislation.gov.uk/uksi/2003/1998/contents/made

NOTE 4 Application to move Special Types or Special Purpose vehicles, such as very large agricultural vehicles, that may not be fully permitted by the Construction & Use (C&U) Regulations or fall outside the scope of the Special Types General Order should be made to the Vehicle Certification Agency (VCA). Their website is at http://www.dft.gov.uk/vca/

*A Special Order application can be completed and submitted online at www.highways.gov.uk/esdal. The Special Order application form BE16 can also be downloaded and e-mailed to the address below. Approval is not automatic and is at the discretion of the Highways England abnormal loads team acting on behalf of the Secretary of State for Transport. To ensure that the necessary clearances can be obtained in good time from the Police, Highway and Bridge Authorities, you should request permission for the move by returning the completed form 10 weeks prior to the scheduled date of the move. In fact you cannot apply too early and we invite manufacturers or hauliers to contact us at pre tender stage, before making a financial commitment to supply the load, to check whether permission would be granted.

** A VR1 application can be completed and submitted online at www.highways.gov.uk/esdal. The form can also be downloaded but must not be e-mailed or faxed because the VR1 form is a legal document and so we must receive the original signed form. Approval is not automatic and is at the discretion of the Highways England abnormal loads team acting on behalf of The Secretary of State for Transport. To ensure that the necessary formalities can be completed in good time, you should request permission for the move by posting the completed form 2 weeks prior to the date of the scheduled move. Again, you cannot apply too early and we invite manufacturers or hauliers to contact us at pre tender stage, before making a financial commitment to supply the load, to check whether permission would be granted.

Forms and enquiries to:
Highways England
Abnormal loads team
9th Floor, The Cube
199 Wharfside Street
Birmingham B1 1RN

E-mail: abnormal.loads@highwaysengland.co.uk
Tel: 0300 470 3004

Appendix 4

Suffolk Police AIL Guidance Document

POLICY

Abnormal Loads Policy

Owning Department:	Protective Services		
Department SPOC:	Abnormal Loads Officer		
Risk Rating:	Low	Legal Sign Off: Date:22.2.21	Alison Ings

Approved by

JNCC:	December 2016		
Published Date:	14/08/2020	Review Date:	14/08/2024

Index

Legal Basis

Legislation/Law specific to the subject of this policy document

Act (title and year)
The Road Vehicles (Construction and Use) Regulations 1986
The Road Vehicles (Authorisation of Special Types) (General) Order 2003
The Road Traffic Act 1960 1988 1991 as amended
The Road Vehicle Lighting Regulations 1989
Regulation 25 of the Road Vehicles Lighting Regulations 1989

Other legislation/law which you must check this document against (required by law)

Act (title and year)
Human Rights Act 1998 (in particular A.14 – Prohibition of discrimination)
Equality Act 2010

Crime and Disorder Act 1998
Health and Safety at Work etc. Act 1974 and associated Regulations
General Data Protection Regulation (GDPR) and Data Protection Act 2018
Freedom Of Information Act 2000
The Civil Contingencies Act 2004

Other Related Documents

- Highways England Abnormal Loads Form and Guidance – July 2012
- Highways Agency Code Of Practice For Self-Escorting Of Abnormal Loads (Department of Transport)
- All Forms can be obtained from the Abnormal Loads Officer in the Roads Armed Policing Team (RAPT).

1. Summary Aim of Policy

1.1 To outline the considerations for policing the safe progress of Abnormal Loads throughout the areas of Norfolk and Suffolk Constabularies.

2. Benefit of Policy

2.1 To provide clarity regarding the responsibilities of the Constabularies in relation to the escorting of Abnormal Loads and the associated procedures.

3. Reason for the Policy

3.1 Norfolk and Suffolk Constabularies recognise their duty under Article 2 of the Human Rights Act 1998 to protect life and the need for safe and efficient transport of Abnormal Loads, including Abnormal Indivisible Loads, on roads within the areas of Norfolk and Suffolk Constabularies.

Purpose

3.2 This policy provides a framework for the management and administration of Norfolk and Suffolk Constabularies responses to escorting Abnormal Loads, including Abnormal Indivisible Loads, within the areas of the Constabularies, and to meet the requirements of legislation and regulations governing their movement. The policy also sets out the standards for the provision of Police Escort service.

4. Description of the Policy

4.1 The responsibility for the safe management of Abnormal Loads lies with the haulier and driver, and is regulated by law. The role of Norfolk and Suffolk Constabularies in respect of most Abnormal Loads is therefore to ensure compliance with the law.

4.2 In accordance with an agreement by the haulage industry, the Highways Agency and National Police Chiefs' Council (NPCC), routine escorting of Abnormal Loads authorised by The Road Vehicles (Authorisation of Special

Types) (General) Order 2003 (STGO) will not be carried out by Norfolk and Suffolk Constabularies but in most cases by the hauliers themselves. Norfolk and Suffolk Constabularies will not escort Abnormal Loads which are up to 5.0 metres wide, except where no alternative arrangement can adequately ensure public safety.

5. What is an Abnormal Load?

5.1 An Abnormal Load is a load which exceeds the following weight and/or dimensions:

- 2.9 metres (9ft 51in) wide;
- 305mm (1ft) lateral projection;
- 44 tonnes in weight;
- 18.65 metres (61ft 2in) load length;
- 25.9 metres (85ft) overall length;
- 3.05 metres (10 ft) front or rear projection;

(The Road Vehicles (Construction and Use) Regulations 1986).

5.2 An Abnormal Indivisible Load is an Abnormal Load that cannot without undue expense or risk of damage be divided into two or more loads for the purpose of being carried on a road (The Road Vehicles (Construction and Use) Regulations 1986).

6. Legislation Covering the Movement of Abnormal Loads

6.1 The movement of Abnormal Loads on the road is covered by STGO, The Road Vehicles (Authorised Weight) Regulations 1998 and regulations 81-82 of The Road Vehicles (Construction and Use) Regulations 1986.

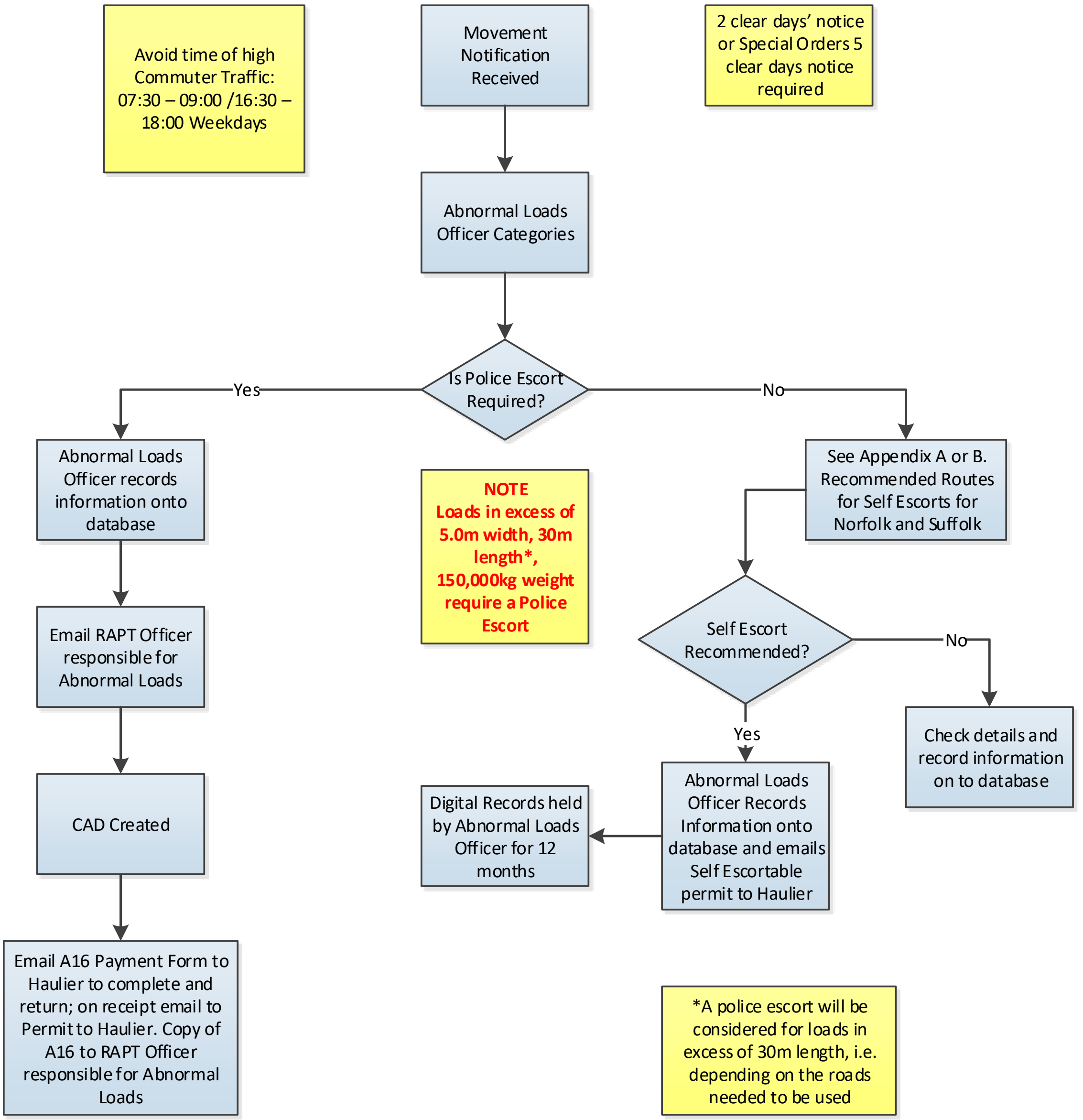
6.2 Norfolk and Suffolk Constabularies recognise the importance (to the economies of the counties) of the ability of the haulage industry to safely, successfully and efficiently transport Abnormal Indivisible Loads on the highways network of Norfolk and Suffolk Constabularies areas. Legislation does not contain any requirement for any Abnormal Indivisible Load to be escorted (Police escorts are requested and charged at SPS rates). Legally enforceable standards exist for the notification of Abnormal Indivisible Load movement to both the Chief Constables and the Road and Bridge Authorities.

6.3 Norfolk and Suffolk Constabularies are not responsible for ensuring the safe operational passage of Abnormal Indivisible Loads on the roads of Norfolk and Suffolk. Unless the Abnormal Indivisible Load is being escorted by the police, this is the role of the Haulier.

6.4 All employees of Norfolk and Suffolk Constabularies should be cognisant of their primary responsibility to preserve life and for public safety.

7. Flowchart 1: Abnormal Loads Process

7.1 Abnormal Loads will not be moved during the hours of darkness (which means the time between half hour after sunset and half an hour before sunrise, as defined by the Road Vehicles Lighting Regulations 1989) in Norfolk or Suffolk without express permission of the Abnormal Loads Officer.



8. Legislation

<u>The Road Vehicles (Authorisation of Special Types) (General) Order 2003 (STGO)</u>

8.1 This Order is a general order made under section 44(1) of the 1988 Road Traffic Act. It authorises road use by certain special types of vehicles, notwithstanding that they do not fully comply with regulations made under section 41 of the 1988 Road Traffic Act. It imposes the restrictions and conditions with which such vehicles must comply, including the extent to which regulations made under section 41 must be observed. Abnormal Indivisible Load vehicles are one of the specific vehicles authorised on permitted road use subject to STGO Regulations. Such vehicles may only be used for the carriage and movement of Abnormal Indivisible Loads.

Highways England Form VR1 (Permit)

8.2 This is required for vehicles / loads with widths exceeding 5.0 metres (16.402" ft) up to 6.1 metres (20.013" ft). The form is completed by the haulier and they only need to supply Norfolk and Suffolk Constabularies with the reference number of the VR1 related to that particular vehicle/load, this can only be done electronically by Electronic Service Delivery for Abnormal Loads (ESDAL) or email.

ESDAL website: https://www.gov.uk/register-with-esdal

Abnormal Indivisible Load movements

8.3 The legislation that permits Abnormal Indivisible Load movements is:

- Road Vehicles Construction and Use Regulations 1986 (C&U)
- Road Vehicles Authorisation of Special Types (General) Order 2003 (STGO)

8.4 C&U Regulations requires hauliers to notify the movement of all Abnormal Indivisible Loads and Abnormal Indivisible vehicles to the Police before moving them by road.

8.5 C&U Regulations is the primary legislation for the construction and maximum dimensions for all vehicles, and is the only legislation that can be used for prosecution purposes.

8.6 STGO permits the use of vehicles and / or loads which cannot comply with the maximum permitted weight, either gross or axle weight, for the class of vehicle being used for transporting a load.

8.7 STGO also contains the regulations for loads that exceed the maximum width permitted by C&U Regulations, agricultural vehicles and many other miscellaneous vehicles.

8.8 The legislation is in the most part permissive, in that providing that the haulier complies with the requirements of notification procedures, an Abnormal Indivisible Load can be moved without the need for any permit or authorisation.

8.9 The only exceptions are as follows:

- Loads exceeding 5.0 metres (16.402" ft) wide which require a VR1 Permit from Highways England, which authorises the movement, but not the route, time or date this has to be arranged with the Police Authority in that particular force area. Once the VR1 has been issued the haulier can then use the normal notification procedure, quoting the VR1 reference.

- Loads exceeding 6.1 metres (20.013” ft) wide, 30 metres (98.42”ft) rigid length or 150,000 kilogram’s (147.63 Tonnes) weight, which require a Special Order from the Secretary of State. A Special Order ensures that the route is negotiable and may lay down certain conditions. It does not, however, replace the notification procedure.

9. Escort Policy

9.1 Norfolk and Suffolk Constabularies will comply with the NPCC recommendation to withdraw from the routine escorting of Abnormal Indivisible Loads.

9.2 The practice of Police Escorting Abnormal Indivisible Loads is a self-imposed duty, established many years ago and initially undertaken for purposes of road safety and to minimise congestion.

9.3 Legislation does not contain any requirement for any Abnormal Indivisible Load to be escorted by the Police.

9.4 The escort criteria adopted by Norfolk and Suffolk Constabularies have been progressively adjusted over time, based on the National Police Chiefs’ Council (NPCC) guidelines

9.5 Norfolk and Suffolk Constabularies require a **minimum** of **2** clear days’ notice for each request for movement. It is the responsibility of the Abnormal Loads Officer to define what type of category the Abnormal Indivisible Load is.

9.6 Any long or short term projects which will increase abnormal loads on the network will be reviewed in accordance with the policy, but the requirement for police or private self-escort provision will be assessed on a project specific basis, to ensure public safety.

<u>Police Escort</u>

9.7 The Norfolk and Suffolk Constabularies Abnormal Loads Officer will carry out a risk assessment of each proposed Abnormal Indivisible Load and a charge will be made for the provision of a Police Escort service.

9.8 It is the responsibility of the Abnormal Loads Officer to determine whether the Norfolk or Suffolk Constabularies will or will not escort an Abnormal Load and will liaise directly with the RAPT Officer responsible for Abnormal Loads regarding individual escorts. Where appropriate it may be necessary to contact RAPT to arrange a suitable Police resource to assist with the safe movement of a load.

9.9 In the event of a load being notified where there may be a public interest; the Abnormal Loads Officer will liaise with the Media Office and all Police Escort will be appear on Norfolk and/or Suffolk Constabulary Webpages.

9.10 In general, no movements are to take place during the hours of darkness (defined above at 7.1), or on Bank Holidays. Movements may not take place during peak holiday or event period(s).

9.11 The Police Escort Process which the haulier has to go through is:

- The haulier must submit a Notification Form, this will then be logged on the Norfolk and Suffolk Constabularies Abnormal load database. The Notification form is the only accepted method of request unless by prior agreement by the Abnormal Loads Officer.
- An A16 Application Form will then be sent to the haulier for them to complete and send back with the relevant information on it.
- A Police Escortable Load Permit, if granted by the Abnormal Loads Officer will then be sent to the haulier to grant them permission to move this vehicle/load(s) on the agreed time, date and route.
- If not approved it is the responsibility of the Abnormal Loads officer to contact the haulier and explain why it has not been approved.
- If approved, the forms will then be sent by the Abnormal Loads Officer to the relevant Police personnel carrying out the escort or anyone else requiring them. The Officer Advice will then be sent to the Police personnel assigned to the movement.

Self-Escort (by, or on behalf of the Haulier)

9.12 Where a load falls below the Special Order criteria, as set out below at paragraph 10:

9.13 The Highways Agency Code of Practice sets guidance for self-escort. As the main purpose is that of safety, if the Abnormal Load Officer or other suitable trained representative of Norfolk and Suffolk Constabularies deem that a self-escort is required, it will then be the requirement of the haulier/company to provide the required level of escort.

9.14 The Self-Escort Process which the haulier has to go through is;

- The haulier must submit a Notification Form, this will be then logged on the Abnormal Load database by the Abnormal Loads Officer.
- Published by Norfolk and Suffolk Constabularies is a list of all key arterial routes and classifications as undertaken by the Constabularies through the County of Norfolk and Suffolk (Appendix A and B). If the dimensions of the vehicle/load exceed the measurements (Appendix A and B) then a "Self-escort" will be required.
- A Self-Escortable Abnormal Load Permit will then be sent to the haulier by the Abnormal Loads Officer if all items are agreed by the Abnormal Loads Officer. If not approved it is the responsibility of the Abnormal Loads Officer to advise the person/company requesting why this is not acceptable.

Non-Escorted Loads

9.15 Where a load falls below the Highways Authority Code of Practice criteria for self-escort, and there are no other safety considerations, then a self-escort will not be required; although the haulier may still provide one.

9.16 Where the Constabularies are required to assist an Abnormal Indivisible Load in order for it to negotiate a contradiction of a road traffic sign, such assistance will not be charged for and will be carried out by suitable trained staff during their normal tour of duty. However, once the assistance has been rendered, the officers should normally end their involvement and return to their policing duties.

9.17 Where the haulier provides their own self / private escort, they are expected to comply with any instructions issued by either Norfolk or Suffolk Constabularies, and to comply with the Highways Agency Codes of practice.

9.18 Where a haulier fails to comply with Constabularies instructions and restrictions or the Highways Agency Code of Practice, offences may be committed in contravention of C&U and STGO Regulations. Additionally, any incidents that occur will be examined in respect of Road Traffic legislation and criminal law.

9.19 Where a Police Escort is provided or assistance is required, upon request by the haulier, it will be conducted by suitable trained officers from the RAPT. These Officers must ensure that the vehicle is roadworthy, and will check all relevant documentation and compatibility with the load to be escorted. RAPT to assist in directing a load at a given point or this may be conducted by other Norfolk or Suffolk Constabularies employees.

9.20 Where a Police Escort is provided, the Constabularies services will recover costs from the haulier on a strictly non-profit basis as follows:

- Normal practice will be that Police Officers from the RAPT, performing overtime on their rest days will be utilised.
- A minimum of five days-notice will be required for the arrangement of a Police Escort.
- Charges to be paid in full in the event of any cancellation or amendment to the movement date, within five working days of the agreed move date.
- Amounts payable due within 14 days of receipt of invoice.

9.21 The Non Escortable Process which the haulier has to go through is;

- To submit a Notification Form, this will be then logged by the Abnormal Loads Officer.
- If the dimensions of the vehicle/load(s) do not exceed the requirements for the route/roads in which they wish to travel along in relation to the Route Classification (Appendix A and B), which has been advised by the Abnormal Loads Officer, a 'Self-Escort' will then not be required.

10. The Highways Agency Code of Practice Criteria

10.1 The Highways Agency Code of Practice criteria for self-escort (excluding motorways) are:

Measurements	Dimensions
Load / Vehicle Width Exceeds	4.1 M 13’6” Feet
Overall Vehicle Length Exceeds	30.5 M 100,00” Feet
Overall Vehicle/Load height Exceeds	4.87 M 16,00” Feet
Vehicle Gross Weight Exceeds	100 Tonnes

11. Restrictions

11.1 Once an Abnormal Indivisible Load movement has been notified to Norfolk or Suffolk Constabularies, restrictions may be placed on the movement. These restrictions normally govern roads, times and/or days that a load is permitted to move. This normally prevents an Abnormal Indivisible Load from travelling during:

- The hours of darkness with the exception of the A12 Essex border to A14 Copdock Interchange and A14 Felixstowe to Cambridgeshire border with width, weight and length restrictions.
- Bank holiday weekends
- During periods where a major event has been planned
- At certain times of days such as “rush hours” high commuter traffic between 07:30 – 09:00 and 16:30 -18:00
- Other times at the discretion of the Abnormal Loads Officer

11.2 Any deviation from the restrictions above can only be given by the Abnormal Loads Officer, having given due consideration to road safety and congestion issues, except in the hours of darkness where authority for any deviation can only be given by either the Contact and Control Room Duty Inspector and or in conjunction with the Duty RAPT Inspector / Sergeant.

11.3 The Abnormal Loads Officer should give due consideration to the Local Highways Authorities’ Street-work(s) Register’s when approving any Abnormal Indivisible Load movement.

11.4 Where a Police Escort is appropriate, the driver of the Abnormal Indivisible Load, his / her attendants and any self / private escort provided will at all times comply with any instructions issued by Norfolk or Suffolk Constabularies, in relation to escorting Abnormal Indivisible Loads.

11.5 The permitting of self / private escorting of Abnormal Indivisible Loads will not remove the requirement of the driver and his / her attendants to comply with the Road Traffic Act or any associated legislation regarding the use of any motor vehicle on a road.

11.6 In the event of any dispute with a haulier over the movement of an Abnormal Indivisible Load, whether escorted or otherwise, a decision will be made by the Abnormal Loads Officer in consultation with the Senior Traffic Officer available. A record should be made of the decision and rationale and will be retained by the Abnormal Loads Officer for a period of one year.

Please Note: *Always refer to the Highways Agency to ensure Policy is up to date.*

12. Administration

12.1 All notifications and enquiries relating to Abnormal Indivisible Loads will be dealt with by the Abnormal Loads Officer.

12.2 On receipt of a notification a reference number will be generated from the Abnormal Loads Database. This will be emailed to Haulier on the Self Escort Permit, or if no Self Escort Permit is issued, retained on the Abnormal Load Database. The original correspondence will be stored digitally and kept for a period of 1 year.

12.3 In the event of a haulier sending notification direct to a Police Station or another Office, the person(s) receiving this correspondence shall immediately contact the Abnormal Loads Officer and arrange forwarding on of the information/request in an appropriate manner.

13. Designated / Undesignated Routes

13.1 Whilst the majority of Abnormal Loads travel along designated routes, if the load is to travel on minor or infrequently used roads, it is the responsibility of the haulier to ensure the route is negotiable and suitable for the vehicle and load. This applies to escorted and non-escorted loads and is carried out in cooperation with the Abnormal Loads Officer.

13.2 The haulier, the Abnormal Loads Officer and / or a Police Escort Officer will check any undesignated route to confirm the suitability for the load(s) notified.

13.3 It is the responsibility of the haulier to check whether any roadworks or road closures, or events that are current or planned, may cause the route to be altered or unsuitable.

14. Abnormal Loads Dispensation

14.1 An Abnormal Loads Dispensation is a document that is issued on an annual basis. This allows hauliers to transport Abnormal Loads only if they meet the required specifications for the 2 particular uses. There are 2 different types of Abnormal Load dispensation which are:

<u>General Dispensations</u>

14.2 General Dispensations Form can be authorised and issued by the Abnormal Loads Officer on the behalf of the Chief Constable, to hauliers / operators who frequently move notifiable Abnormal Loads up to a maximum width of 3.5metres (11.45" ft).

14.3 This allows movement of specific loads without the requirement to notify Norfolk and/or Suffolk Constabulary 2 clear days in advance. The dispensation relates only to the vehicles operated by the named company.

14.4 No movement under the dispensation shall take place during in the hours of darkness.

14.5 Each load so authorised must have a copy of the dispensation in the driver's possession and must be valid from 1st January to 31st December depending on when they apply or part year thereof from date of issue.

14.6 Back dating of certificates is not permitted in any circumstance.

14.7 These dispensations are granted pursuant to paragraphs 2(4) and 4(2) of schedule 5 to the STGO Regulations which gives discretion to the Abnormal Loads Officer to accept shorter notice periods and fewer details than those otherwise required by schedule 5.

Agricultural Dispensations

14.8 Agricultural Dispensations Form can be authorised and issued by the Abnormal Loads Officer on the behalf of the Chief Constables, to farmers, farm companies and farming contractors, who can demonstrate the need to move agricultural vehicles, implements and appliances on public roads in the course of their business. This is subject to the agreement of the Norfolk and Suffolk Constabularies Abnormal Loads Officer.

14.9 The dispensation allows the holder to move agricultural machinery up to a maximum of 4.3 metres (14.10" ft), on public roads within a radius of 25 miles (40.23 Km) of the operating base, without the requirement of giving 24 hours' notice to the police.

14.10 All movements are subject to compliance with safety conditions, in respect of attendants, signing and 'self-escorts'. Each machine authorised will have a copy of the dispensation in the driver's possession and is valid from 1st January to 31st December depending on when they apply or part year thereof from date of issue, back dating of certificates is not permitted in any circumstance.

14.11 These dispensations are granted pursuant to paragraphs 2(4) and 4(2) of schedule 5 to the STGO Regulations which gives discretion to the Abnormal Loads Officer to accept shorter notice periods and fewer details than those otherwise required by schedule 5.

15. Abnormal Load Summary Requirements – Aide Memoire

15.1 The following vehicles are required to give Norfolk and/or Suffolk Constabulary **2** clear days (i.e. 48 hours) notice before any movement can be authorised through the county:

Width:

- Below 2.9m (9'6") = no notification
- Between 2.9m (9'6") and 4.3m (14'1") wide (this being the total width including any projection) = 2 clear days (i.e. 48 hours) written notice

Please Note: *Anything above 3.5m (11'6") may require a self-escort vehicle*

- Above 5.0m (16'40") wide = requires VR1 issued by the Highways England

Length:

- Below 18.65m (61') = no notification
- Between 18.65m (61') and 27.4m (90') = 2 clear days written notice.
- For some light loads where the rigid length exceeds 27.4m (89'11") such as yacht masts moved on conventional motor vehicles not exceeding 12 tonnes gross weight or trailers not exceeding 10 tonnes gross weight a Highways England Special Order will be required.
- Over 30m (98'5") requires a Special Order issued by Highways England

Please Note: *that the length does not include the traction unit (cab), unless some of the load is being carried on it*

Weight:

- Below 44,000KG = no restrictions
- Between 44,000-50,000KG = 2 clear days' notice* to Road and Bridge Authorities
- Between 50,000-80,000KG = 2 days police notice and 5 days to Highways England and Bridge authorities
- Between 80,000KG-150,000KG = 2 clear days' notice to Police and 5 clear days with indemnity to Road and Bridge Authorities
- Over 150,000KG = Highways England Special Order plus 5 clear days' notice to Police and 5 clear days' notice with indemnity to Road and Bridge Authorities

**Clear days' notice excludes Saturdays, Sundays or a public holiday in any part of Great Britain in relation to movements authorised by the Special Types General Order only, there being no such exclusion in Special Orders unless specifically stated.*

15.2 Application to move Special Types or Special Purpose vehicles, such as very large agricultural vehicles, that may not be fully permitted by the

Construction and Use (C&U) Regulations or fall outside the scope of the Special Types General Order should be made to the Vehicle Certification Agency (VCA). The VCA website is http://www.dft.gov.uk/vca/

15.3 Self escort is defined as an accompanying vehicle, operated independently of the Abnormal Load. See Highways England Code of Practice Lighting and Marking for Abnormal Load Self Escorting Vehicles Incorporating Operating Guidance.

(Police escorts can be utilised but at a cost to the haulier)

16. Roles and Responsibilities

Role Title	Responsibilities
Abnormal Loads Officer	As the Abnormal Loads Officer, you are responsible for / must / should do: • The administration and route assessment of notified Abnormal Loads within the County of Norfolk and /or Suffolk. • Receive telephone calls and enquiries regarding Abnormal Loads and issue appropriate permits where necessary. • Determine whether an Abnormal Load requires a Police Escort. • Liaise with other Forces and agencies concerning the movement of an Abnormal Load. • Arrange for routes to be checked regarding extremely large loads. • On behalf of the Chief Constables where appropriate, authorise and issue both General and Agricultural annual Dispensations. • Liaise with the Media Office and the local media of any load movement which may be of public interest. • Give statements and attend Court as a witness when required. • Attend any relevant meetings that are deemed appropriate.
RAPT	You are responsible for / must / should do: • Check that the vehicle, the load and documentation comply with the relevant traffic regulations. Confirm suitability of any undesignated route. • Before commencing escort duties, consideration should be given to the weather, light and traffic conditions. • Warn other road users of the presence of an Abnormal Load and to assist with safe passage.

Appendix A: Self Escort Guide (Suffolk)

Effective from 23rd September 2020

SELF ESCORTS WILL BE EXPECTED WHERE THE BELOW DIMENSIONS ARE EXCEEDED.

Please note: Night movements are not routinely allowed without express permission of the Abnormal Loads Officer.

1. Loads that exceed 4.1m (13'5') wide, 30m (98') or 100 tons in weight

- The A11 south of Barton Mills,
- The A12 south of Ipswich
- The whole length of the A14 from Cambridgeshire to Felixstowe Docks
- (And all the roads below)

2. Loads that exceed 4.0m (13' 1") wide, 30m (98') long or 80 tons in weight

On all other 'A' roads (with the exception of those 3 above)

(And all the roads below)

3. Loads that exceed 3.80m (12' 6") wide, 27.4m (89') long or 80 tons in weight

- The A134**, A143**, A144*&#, A145*&##, A1065* (from A11 to Omar Homes), A1088***, A1092***, A1094 from the A12 to Aldeburgh Golf Club, A1095, A1117, A1152, A1120 roads
- A1071 – Hadleigh to Ipswich Police Escort to be considered
- (And all the roads below)

4. Loads that exceed 3.65m (12') wide, 27.4 m (89') long or 80 tons in weight

- On the A12 through Lowestoft,
- The A134*, A143 & A1302* roads through Bury St Edmunds,
- The A142 through Newmarket,
- The A1101 through Mildenhall from the A11 to R A F Mildenhall & beyond,
- The A1065 through Brandon town,
- The A1071
- The A146 Ellough to Carlton Colville
- The A1117
- (And all road below)

5. Loads that exceed 3.50m (11' 6") wide, 27.45m m (89') long or 80 tons in weight

- The A144 through Halesworth & Bungay #
- The A145 through Beccles, ##
- The A1094 through Aldeburgh from the Golf Club to Church Farm Caravan Park & the Quay,
- The A1095 from the A12 through Southwold to Adnams Brewery & the Quay area,
- The A1304 through Newmarket town
- All 'B' and 'C' class roads, unless a short distance from main 'A' roads - i.e. Carlton Mere (formally Lakeside) Caravan Park, Saxmundham from A12 road at Saxmundham by pass.
- All unclassified roads in the County.

Private Escort vehicles should fully conform to Highways Agency Code of Practice

Loads with excess, width, length, overhang or height will be judged on their individual needs and the haulier will be notified accordingly. This is a guide only and all movements will be assessed by Abnormal Loads Officer according to Force Policy. This guide is subject to change.

* Weight restrictions will prevent loads over 'C&U' weights using these roads (or parts of these roads)

(Suffolk County Council will confirm prohibitions)

** 'Traffic calming' measures will prevent some loads using these roads or parts of these roads altogether.

*** Environmental weight limits will prohibit lower than 'C&U' limits using parts of these roads.

To avoid Bungay town centre the B1062 to the A143 at Homersfield should be used.

To avoid Beccles town centre use the A12, A1117 & A146 roads instead of the A145.

Appendix B: Self Escort Guide (Norfolk

Effective from 23rd September 2020

NORFOLK CONSTABULARY RECOMENDS THE USE OF A SELF ESCORT VEHICLE FOR THE ROUTES BELOW

SELF ESCORTS WILL BE EXPECTED WHERE THE BELOW DIMENSION ARE EXCEEDED.

*****Please Note: No movements during hours of darkness, unless authorised by Abnormal Loads Officer*****

1. Loads which exceed 4.1m (13’ 6”) wide 30.m (98’) long or 100 tonnes

- A11 Thetford to Norwich & reverse
- A47 Wisbech to Acle & reverse
- A12 Gt Yarmouth to Suffolk border & reverse
- A1270 NDR

2. Loads which exceed 4.m (13’ 1”) wide 30.m (98’) long or 100 tonnes

- **^** A140 Scole to Norwich & reverse
- ^ A140 Norwich ring road north to Cromer & reverse
- ^A146 Gillingham north to A47 & reverse
- A10 Kings Lynn south to Cambs border at Brandon Creek & reverse
- A148 Kings Lynn to Cromer & reverse (caution at Letheringsett)
- A143 Scole to junc of A146 & reverse)
- A1066 Thetford to Scole
- A1122 junction of the A10 to A47
- A1067 Norwich to Fakenham
- A1074 junction of the A47 to Norwich
- A1078 junction of A148 to Bentinck Dock, Kings Lynn
- ^ A134 Thetford to junc of A10 & reverse

3. Loads which exceed 3.81m (12’ 6”) wide 27.4.m (90’) Long or 80 tonnes

- A149 (junc of A148) north of Kings Lynn to Hunstanton & reverse
- A149 Gt Yarmouth to Caister-on-Sea & reverse
- A1065 Brandon to Swaffham & reverse

- A1101 Junction of the A47 to Outwell
- A1088 Thetford to Euston
- *A134 Thetford to Bury St Edmunds 3.8m restriction Bury Road, Thetford*(HGV diversion signposted via A11)

4. Loads which exceed 3.65m (12') wide 27.4m (90') Long or 80 tonnes

- A1122 Downham Market to Outwell
- A149 Hunstanton to Cromer & reverse
- B1159 Cromer to Caister-on-Sea & reverse
- A143 (Junc of A146) to A12 (Bradwell – Belton – Burgh Castle area's)
- B1140 – (Junc of A47) south to Cantley - Reedham & reverse
- Brundall boatyards (off A47)
- A1151 Norwich to Smallburgh (serving all boatyards)
- A1062 Hoveton to Potter Heigham (serving all boatyards & Caravan sites)
- A149 Smallburgh to Gt Yarmouth (serving all boatyards)
- Any other 'B' class road (unless short distance from 'A' roads)
- A1082 junction of A148 to Sheringham

5. Loads which exceed 3.5m (11' 6") wide 27.4m (90') Long or 80 tonnes

- A47 Acle to Great Yarmouth (Acle Straight)
- A1064 Acle to Filby j/w A149
- A1075 Thetford to Dereham
- A1101 Outwell to Welney and border
- All 'C' class roads (unless short distance from main 'A' roads)

6. Loads which exceed 3.35m (11') wide 27.4m (90') Long or 80 tonnes

- A1065 Swaffham to Fakenham (caution at Raynham)
- All unclassified roads in the county

7. Loads which exceed 3.2m (10' 6") wide 27.4m (90') Long or 80 tonnes

- B1436 Felbrigg road to Thorpe Market

8. Any other routes recommended by the Abnormal Loads Officer

- **^ '**Traffic calming' measures will prevent some loads from using these roads or parts of these roads.

- Weight restrictions over ‘C and U’ Limits on parts of these roads

Please Note: *Loads with excess width, length, overhang or height will be judged on their individual needs and the haulier will be notified accordingly. This is a guide only and all movements will be assessed by Abnormal Loads Officer according to Force Policy. This guide is subject to change.*

<u>HEIGHT RESTRICTION;</u>

Any load over 5m (16’6”) High Must inform BT and EDF.

Appendix 5

Summary of Suffolk Country Council Structures

Date Received	Movement No	Area / CC	Haulier Vehicle	Feasibility Reference	Summary	Notes	Column1
01/07/2021	28303	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead to Bures Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 1 - Twinstead	OK	No structures / restrictions	
01/07/2021	28304	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead to Bures Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 2 - Lamarsh	OK	No structures / restrictions	
01/07/2021	28305	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead to Bures Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 3 - Workhouse Green	OK but FULL CAUTION on 1 Structure - AIP from SH to be requested for further investigation / 'caution' approval	Bridge no 2828 Old Victoria Culvert on the A134 about 3.24 miles SE of Bury St Edmunds and about 0.07 miles SE of Sicklesmere (0.748474°E 52.209494°N), has a special axle weight limit which is less than the 16.5te maximum axle weight of vehicle WYN-FB-4-4.	
01/07/2021	28306	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead to Bures Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 4 - Dorking Tye	FULL FAIL on 1 Structure	Bridge no 1514 Bures on the B1508 about 5.47 miles SE of Sudbury and about 0.05 miles SE of Bures (0.773843°E 51.972111°N), has a special weight limit which is less than the 108.3te weight of vehicle WYN-FB-4-4	
01/07/2021	28307	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Leavenheath to Polstead Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 5 - Stewards Farm	OK but FULL CAUTION on 1 Structure - AIP from SH to be requested for further investigation / 'caution' approval	Bridge no 2828 Old Victoria Culvert on the A134 about 3.24 miles SE of Bury St Edmunds and about 0.07 miles SE of Sicklesmere (0.748474°E 52.209494°N), has a special axle weight limit which is less than the 16.5te maximum axle weight of vehicle WYN-FB-4-4.	
01/07/2021	28308	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Leavenheath to Polstead Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 6 - Orchard	OK but FULL CAUTION on 1 Structure - AIP from SH to be requested for further investigation / 'caution' approval	Bridge no 2828 Old Victoria Culvert on the A134 about 3.24 miles SE of Bury St Edmunds and about 0.07 miles SE of Sicklesmere (0.748474°E 52.209494°N), has a special axle weight limit which is less than the 16.5te maximum axle weight of vehicle WYN-FB-4-4.	
01/07/2021	28309	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Leavenheath to Polstead Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 7 - Whitestreet Green	OK		
01/07/2021	28310	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Leavenheath to Polstead Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 8 - Holt Road	OK		
01/07/2021	28311	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Leavenheath to Polstead Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 9 - Polstead Heath West	OK		
01/07/2021	28312	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Leavenheath to Polstead Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 10 - Polstead Heath East	OK		
01/07/2021	28313	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Leavenheath to Polstead Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 11 - Layham Quarry	OK		
01/07/2021	28314	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Leavenheath to Polstead Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 12 - Layham Quarry	OK		
21/09/2021	30906	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Bramford to Twinstead - Cable Drum - WYN-FB-4-4 - ROUTE 1	OK - 3 Structures - AIP from SH to be requested for further investigation / approval	OK, but Structure checks made based on current limited 'simple' data held. Three structures affected - 1235 Assington Hall (E 593618 , N 238595) 2446 Dorking Tye (E 592428 , N 236819) 1642 Nayland Bypass CLVRT (E 596991 , N 233929) AIP from SH to be requested by AP for further investigation / approval	
21/10/2021	30927	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead Cripple Corner New Access 58 / 56 - Cable Drum - WYN-FB-4-4 - ROUTE 1A - Twinstead	OK	No structures / restrictions	
21/10/2021	30928	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead Cripple Corner New Access 58 / 56 - Cable Drum - WYN-FB-4-4 - ROUTE 1B - Twinstead	OK	No structures / restrictions	
21/10/2021	30929	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead Cripple Corner New Access 58 / 56 - Cable Drum - WYN-FB-4-4 - ROUTE 1C - Twinstead	OK	No structures / restrictions	
21/10/2021	30930	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead Cripple Corner New Access 58 / 56 - Cable Drum - WYN-FB-4-4 - ROUTE 1D - Twinstead	OK	No structures / restrictions	
21/10/2021	30931	Suffolk CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead to Bures Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 2A - Lamarsh	OK	No structures / restrictions	

Appendix 6

Summary of Essex Country Council Structures

Date Received	Movement No	Area / CC	Haulier Vehicle	Feasibility Reference	Summary	Notes	Column1
01/07/2021	41491	Essex CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead to Bures Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 1 - Twinstead	FULL FAIL on 1 Structure	Bridge no 43/42624 Town Bridge Halstead on the A131 about 0.12 miles E of Halstead and about 1.38 miles E of Whiteash Green (0.635218°E 51.943479°N), cannot accept abnormal load vehicles	
01/07/2021	41492	Essex CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead to Bures Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 2 - Lamarsh	FULL FAIL on 2 Structures	Bridge no 54/42628 Ford Street on the A1124 about 5.35 miles W of Colchester and about 0.17 miles W of Fordstreet (0.790225°E 51.909310°N), cannot accept abnormal load vehicles. Bridge no 697/43179 Brook House Culvert on the A1124 about 5.60 miles NE of Coggeshall and about 0.37 miles NE of Fordstreet (0.783652°E 51.913522°N), cannot accept abnormal load vehiclesv	
01/07/2021	41493	Essex CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead to Bures Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 3 - Workhouse Green	OK		
01/07/2021	41494	Essex CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead to Bures Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 4 - Dorking Tye	OK		
21/09/2021	43757	Essex CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Bramford to Twinstead - Cable Drum - WYN-FB-4-4 - ROUTE 1	OK		
21/10/2021	43776	Essex CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead Cripple Corner New Access 58 / 56 - Cable Drum - WYN-FB-4-4 - ROUTE 1A - Twinstead	OK - But still FULL FAIL on 1 Structure	Bridge no 43/42624 Town Bridge Halstead on the A131 about 0.12 miles E of Halstead and about 1.38 miles E of Whiteash Green (0.635218°E 51.943479°N), cannot accept abnormal load vehicles	
21/10/2021	43777	Essex CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead Cripple Corner New Access 58 / 56 - Cable Drum - WYN-FB-4-4 - ROUTE 1B - Twinstead	OK - But still FULL FAIL on 1 Structure	Bridge no 43/42624 Town Bridge Halstead on the A131 about 0.12 miles E of Halstead and about 1.38 miles E of Whiteash Green (0.635218°E 51.943479°N), cannot accept abnormal load vehicles	
21/10/2021	43778	Essex CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead Cripple Corner New Access 58 / 56 - Cable Drum - WYN-FB-4-4 - ROUTE 1C - Twinstead	OK - But still FULL FAIL on 1 Structure	Bridge no 43/42624 Town Bridge Halstead on the A131 about 0.12 miles E of Halstead and about 1.38 miles E of Whiteash Green (0.635218°E 51.943479°N), cannot accept abnormal load vehicles	
21/10/2021	43779	Essex CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead Cripple Corner New Access 58 / 56 - Cable Drum - WYN-FB-4-4 - ROUTE 1D - Twinstead	FULL FAIL on 1 Structure	Bridge no 50/42640 Stone on the A1124 about 2.55 miles E of Halstead and about 0.85 miles E of Earls Colne (0.682397°E 51.930371°N)	
21/10/2021	43780	Essex CC	Misc - G/N 8A	FEASIBILITY - AIL Access Study - Twinstead to Bures Study Area - Cable Drum - WYN-FB-4-4 - ROUTE 2A - Lamarsh	OK		
19/04/2022	48768	Essex CC	MAM - G/F 16A	FEASIBILITY - AIL Access Study - Tilbury Docks to Brimsdown Substation - Transformer - MAM-4-16-4 - ROUTE 1	OK		
19/04/2022	48769	Essex CC	MAM - G/F 16-WA	FEASIBILITY - AIL Access Study - Tilbury Docks to Brimsdown Substation - Transformer - MAM-4-16-4W - ROUTE 1	OK		
19/04/2022	48770	Essex CC	MAM - G/F 18A	FEASIBILITY - AIL Access Study - Tilbury Docks to Brimsdown Substation - Transformer - MAM-4-18-4 - ROUTE 1	OK		
19/04/2022	48771	Essex CC	ALL - G/F 16A	FEASIBILITY - AIL Access Study - Tilbury Docks to Brimsdown Substation - Transformer - ALL-4-16-4 - ROUTE 1	OK		
19/04/2022	48772	Essex CC	COL - G/F 20A	FEASIBILITY - AIL Access Study - Tilbury Docks to Brimsdown Substation - Transformer - COLL-4-20-4 - ROUTE 1	OK		
09/05/2022	48774	Essex CC	MAM - G/F 16A	FEASIBILITY - AIL Access Study - Tilbury Docks to Brimsdown Substation - Transformer - MAM-4-16-4 - ROUTE 2	OK		
09/05/2022	48775	Essex CC	MAM - G/F 16-WA	FEASIBILITY - AIL Access Study - Tilbury Docks to Brimsdown Substation - Transformer - MAM-4-16-4W - ROUTE 2	OK		
09/05/2022	48776	Essex CC	MAM - G/F 18A	FEASIBILITY - AIL Access Study - Tilbury Docks to Brimsdown Substation - Transformer - MAM-4-18-4 - ROUTE 2	OK		
09/05/2022	48777	Essex CC	ALL - G/F 16A	FEASIBILITY - AIL Access Study - Tilbury Docks to Brimsdown Substation - Transformer - ALL-4-16-4 - ROUTE 2	OK but CAUTION on 1 Structure	Bridge no 317/42871 Clarks Bridge on the A121 about 1.03 miles E of Waltham Cross CAUTION ALL CARRIAGEWAYS - the vehicle may ONLY cross such bridges if ALL other traffic is EXCLUDED from the structure (ALL CARRIAGEWAYS - NO EXCEPTIONS) and the vehicle proceeds at LOW SPEED using the CENTRE of the carriageway, whilst the Police or any escorting vehicles should remain behind until the vehicle has crossed the entire Structure	
09/05/2022	48778	Essex CC	COL - G/F 20A	FEASIBILITY - AIL Access Study - Tilbury Docks to Brimsdown Substation - Transformer - COLL-4-20-4 - ROUTE 2	OK		

Appendix 7

Summary of National Highways A12 & A14 Structures

Andy Pearce

From: Anum, Emmanuel [redacted]
Sent: 20 September 2021 20:20
To: Andy Pearce
Cc: Hyde, Nicolas; Cornwell, Lee; Jones, Bob
Subject: RE: Bramford to Twinstead project - STGO Access for Cable Drums

Andy,

Please see below my response to your email below in red texts.
Thanks.

Kind Regards

Emmanuel Anum

Emmanuel Anum, Senior Engineer
Abnormal Loads (Structures)
Operations (East) | National Highways
Woodlands | Manton Lane | Bedford | MK41 7LW
Mob: [redacted] | www.highwaysengland.co.uk

From: Andy Pearce [mailto:[redacted]]
Sent: 17 September 2021 14:36
To: Anum, Emmanuel [redacted]
Cc: Hyde, Nicolas <[redacted]uk>; Cornwell, Lee [redacted]; Jones, Bob <[redacted]>
Subject: RE: Bramford to Twinstead project - STGO Access for Cable Drums

Good afternoon Emmanuel,

Thank you for this which does make sense. Brief comments below.

- The A14 work arounds including at Stowmarket are understood from previous transformer moves but confirmation of the exact limits on the interchange bridges is helpful.

  At the Stowmarket area there are some quite onerous weight limitations (52 tonnes) at junctions 50 and 51 on the A14 as shown below.

A14

- 52 tonne limit; A14 Junction J50 09971 A14/170.10// Cedars I/C South 606860E 258500N best use the slip roads
- 52 tonne limit; A14 Junction J50 09972 A14/170.00// Cedars I/C North 606760E 258565N best use the slip roads
- 52 tonne limit; A14 Junction J51 09960 A14/176.00// Beacon Hill I/C South 610840E 254200N best use the slip roads
- 52 tonne limit; A14 Junction J51 09961 A14/175.90// Beacon Hill I/C North 610770E 254290N best use the slip roads

You will be required to use the slip-roads at junctions 50 and 51 on A14.

- On the A12 as we are showing 108te nett on our current indicative trailer we are just about within the 110te limit on Orchard Railway. The 90te limit on Whitehouse Bridge would only apply if we came in from Colchester (or Harwich) as it is the link back to A12 north if I have understood correctly and would be crossed under if remaining on the main carriageway but can be avoided.

Although not confirmed to date I had some discussion with National Grid last week and the weight of the cable drums may in fact be reduced which will help but we are assuming this as worst case for now.
I think you should be fine with Orchard Railway. It is true that the 90te limit on Whitehouse Bridge would only apply if you are to come in from Colchester.

- I think the network issues in terms of width and length can probably be discussed nearer the time in discussions with the police in terms of escort requirements. The final access roads on the county road network are very limited as you can imagine and discussions with the police have taken place to discuss escorts so they are aware of what is proposed.
Could you please discuss the network issued with Lee Cornwell (National Highways) to ensure that he has happy with the movement on the network.

- One aside is that although this will be acceptable for what we are looking at here for the Bramford to Twinstead project there is a possible issue for top end STGO loads potentially required for Sizewell C in the future which exceed the A12 Orchard Railway restriction and the 132te limit at A12 Stratford St Mary. This is someway down the line of course but should be noted.
We are always here to help, and so we can discuss the movement when we get the proposed details.

This is exactly the sort of information we needed and will inform our reporting so thank you once again.

Kind Regards

Andy Pearce
General Manager (IOSH)
Tel: [redacted]
Shaftesbury House, High Street, Eccleshall, Staffordshire ST21 6BZ, UK
Mobile: + [redacted]
wynnslimited.com
Registered in England & Wales No. 3162297

From: Anum, Emmanuel <E[redacted]
Sent: 15 September 2021 13:36
To: Andy Pearce [redacted]
Cc: Hyde, Nicolas [redacted]>; Cornwell, Lee <[redacted]
Subject: RE: Bramford to Twinstead project - STGO Access for Cable Drums

Hi Andy,

I want to make you aware of the weight restrictions on A14 and A12 and A120 if we are to assume the full corridors of these routes for the proposed movements.

A14 Full Corridor

- 112 tonne limit; A14 Junction 42 Bury St Edmunds Western 10014 A14/142.60// Western I/C East 582678E 265427N best use the slip roads

- 112 tonne limit; A14 Junction 42 Bury St Edmunds Western 10015 A14/142.50// Western I/C West 582520E 265455N best use the slip roads
- 112 tonne limit; A14 Junction 43 Bury St Edmunds Central 10009 A14/145.60// Central I/C East 585692E 265316N best use the slip roads
- 112 tonne limit; A14 Junction 43 Bury St Edmunds Central 10010 A14/145.50// Central I/C West 585561E 265393N best use the slip roads
- 112 tonne limit; A14 Junction 44 Bury St Edmunds East 10004 A14/147.70// Eastern I/C East 586755E 263607N best use the slip roads
- 112 tonne limit; A14 Junction 44 Bury St Edmunds East 10005 A14/147.60// Eastern I/C West 586650E 263654N best use the slip roads
- 112 tonne limit; A14 Stowmarket 09978 A14/167.80// Newton Road 604948E 259692N route through Stowmarket
- 52 tonne limit; A14 Junction J50 09971 A14/170.10// Cedars I/C South 606860E 258500N best use the slip roads
- 52 tonne limit; A14 Junction J50 09972 A14/170.00// Cedars I/C North 606760E 258565N best use the slip roads
- 52 tonne limit; A14 Junction J51 09960 A14/176.00// Beacon Hill I/C South 610840E 254200N best use the slip roads
- 52 tonne limit; A14 Junction J51 09961 A14/175.90// Beacon Hill I/C North 610770E 254290N best use the slip roads

Unfortunately, there are some quite onerous weight limitations on the A14 at junctions 42, 43, 44, 50 and 51. The most onerous to avoid is Newton road which will require rerouting through Stowmarket.
In order to avoid the structure at each of these junctions, you may have to use the slip roads and then back onto the A14. Please check the respective weight restrictions at each junction on the link above.

A12 Full Corridor

- 88 tonne limit; A12 Lowestoft 05929 A12/176.80// Lowestoft Bascule 654758E 292715N northbound and southbound
- 140 tonne limit; A12 Junction J25 24331 A120/59.60// Marks Tey Rail 591171E 223637N A12 to A120 East and Westbound
- 90 tonne limit; A12 Junction J29; 05872 A12/81.60// Whitehouse 601980E 229220N northbound from J29 A120 west/northbound
- 132 tonne limit; A12 Stratford St Mary 05887 A12/87.90// Church Bridge Stratford 605085E 234633N both directions
- 110 tonne limit; A12 Colchester 05860 A12/75.20// Orchard Railway 597199E 226419N both directions

You could potentially reroute through Colchester and re-joining the A12 probably at junction 28 or 27 thus avoiding Orchard Railway if your gross weight exceeds the weight limitations of 110 te.
In rerouting through Colchester please be aware of the 90 te weight limitation at Whitehouse. Should you find yourself rerouting and traveling westward along the A120; Whitehouse (90 te limit) can be avoided by continuing westward and doing a U-turn at A12 Junction 28.

A12 Full Corridor

- 140 tonne limit; A120 near Braintree 24329 A120/48.0// Blackwater 580690E 223122N both directions River Blackwater crossing.

I noticed on the attached drawing that the overall length of the vehicle is **26.483m**, rigid length is **21.442m** and overall height is **4.834m.** I believe these dimensions should be OK.
However, I noticed that the overall width is **4.500m.** I think Lee would have to comment on this because this becomes a network issue instead of structural issue.

With respect to the new improvement plans on A120, A12 and at Copdock interchange I am not involve with the schemes therefore I can't give any information. However, I don't know if Lee would be able to advise what is planned and provide any useful information.
My understanding from the attached drawing is that the cable drum is 60 te whereas the combined weight is 108.3 te. If this is the case then I don't think we would have much problem with the proposed movements.

I hope this information is very useful. Please let me know if your query has been addressed or alternatively you could call me on the number below for further clarification if that will help.
Again thanks for your patience.

Kind Regards

Emmanuel Anum

Emmanuel Anum, Senior Engineer
Abnormal Loads (Structures)
Operations (East) | National Highways
Woodlands | Manton Lane | Bedford | MK41 7LW
Mob: [redacted] | www.highwaysengland.co.uk

From: Anum, Emmanuel
Sent: 13 September 2021 14:29
To: Andy Pearce [redacted]; Hughes, John [redacted]
Cc: Hyde, Nicolas [redacted]
Subject: RE: Bramford to Twinstead project - STGO Access for Cable Drums

Hi Andy,

Sorry for the delay in getting back to you. John told me he was going to respond to your message so I thought the issue has already been sorted out.

John is on retirement now so please I will have a look and get back to you soon.
Thank you for your patience.

Kind Regards

Emmanuel Anum

Emmanuel Anum, Senior Engineer
Abnormal Loads (Structures)
Operations (East) | National Highways
Woodlands | Manton Lane | Bedford | MK41 7LW
Mob: [redacted] | www.highwaysengland.co.uk

From: Andy Pearce [redacted]
Sent: 10 September 2021 10:13
To: Anum, Emmanuel [redacted]; Hughes, John [redacted]
Cc: Hyde, Nicolas [redacted]
Subject: FW: Bramford to Twinstead project - STGO Access for Cable Drums

Emmanuel/John,

I do not appear to have had any response to my email below. I presume the STGO loads do not present an issue on A12, A14 and A120 but would be grateful if you could please confirm this.

Kind Regards

Andy Pearce
Gener[redacted]
Tel: +[redacted]

Shaftesbury House, High Street, Eccleshall, Staffordshire ST21 6BZ, UK
Mobile: +[redacted]
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Registered in England & Wales No. 3162297

From: Andy Pearce
Sent: 28 May 2021 14:53
To: [redacted] Hughes, John [redacted]
Cc: Hyde, Nicolas [redacted]
Subject: Bramford to Twinstead project - STGO Access for Cable Drums

Emmanuel/John,

Further to our meeting on 30.3.21 please see attached an indicative cable drum transport arrangement drawing that is potentially one which could be considered for the cable drum access associated with the locations on the Bramford to Twinstead overhead line upgrade project between the existing Bramford Substation and the proposed new Twinstead Substation. As these loads are STGO it is not possible at this stage to confirm where they will enter the UK and they could in theory enter the HE East network at any suitable point so it is probably best to assume access from either M1 or A1 if coming from the north and onto A14 eastbound or from M25 and the up either the M11 and A120 or on the A12 if they approach from the south.

We are considering multiple locations along the overhead line route and the point at which we exit the trunk road network onto Essex CC or Suffolk CC roads also remains to be confirmed so I think we need to assume the full corridors of the A14 and A12 and A120 are needed. Possible egress could be at the following junctions from either direction unless stated:

- A14 – A134 Jct 44 at Bury St Edmunds
- A14 – A1214 Jct 55 at Ipswich
- A12 – A1124 Jct 26 at Colchester. Load could exit north towards Halstead or south and east to Colchester.
- A12 – Jct 27 eastbound at Colchester.
- A12 – Jct 28 at Colchester Football Club. Note this may then need the bridge carrying the B1508 over A12 Colchester Road to be considered.
- A120 – A131 Jct at Braintree
- A120 – B1024 Colne Road Jct at Coggeshall Bypass

Hopefully there are no major issues for SGTO load as shown but I would be grateful if you could advise if there are any structural concerns on the HE East network.

Appendix C
Abnormal Indivisible Load Report for Super Grid Transformers

Bramford to Twinstead Connection Project - Abnormal Indivisible Load Access for 178te Transformers to Proposed Twinstead Substation

DRAFT REPORT Prepared for National Grid

Shaftesbury House, High Street, Eccleshall, Staffordshire ST21 6BZ, UK
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NAME		SIGNATURE	DATE
Prepared by:	Andy Pearce	[redacted]	20.01.23
Checked by:	Peter Wynn		23.01.23
Approved by:	Andy Pearce		23.01.23

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Any conclusions, calculations or findings presented here should not be changed or altered.

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DOCUMENT REVISIONS

Issue	Date	Details
0	23.01.23	DRAFT Report
1		
2		

Contents

Executive Summary

The contents of this report include transport feasibility investigations into achieving access to National Grids (NG) proposed Twinstead Substation, for Special Order movements of above 150te gross loads as part of a substation development scheme associated with the Bramford to Twinstead reinforcement project. The weight considered in these investigations is 178te nett which is advised by National Grid, to be the weight of the new bulk purchase transformer required at the substation in 2023/24.

Due to the overall transport weight of the load being considered (plus carrying trailer) being in excess of 150te gross weight, the move will require a Special Order from National Highways (NH). It should be noted that Government policy is to maximise the use of water for the movement of Special Order (above 150te gross) AIL's wherever possible. NH require that access via the nearest available water access should be considered, as NG would be required to deliver via the nearest available marine offloading point that is practicable for AIL delivery. NG have an Agreement in Principle (AiP) from NH dated 05.05.21 which confirms that the NHs preferred port of delivery is Tilbury (AIP Reference 784).

The port of Tilbury is able to accommodate a variety of solutions for delivery of transformers and has not been specifically investigated in this report, but it is widely used for AIL access in the south east to NG substations.

The route from Tilbury to Twinstead has been cleared by all structural authorities. However, this has only been secured on 16 axle trailers as 20 axle trailers have been advised as unsuitable on the M11 at National Highways East Region. In addition, Essex County Council required that the A131 Town Bridge in Halstead was assessed in order to confirm its suitability for the proposed loads. This has been undertaken by the third party consulting engineers Wallace Stone and the bridge has been deemed as acceptable to all trailer arrangements. Final written confirmation remains outstanding from Essex County Council in terms of agreeing the final check certificates but no major issues are expected.

The route from Tilbury is considered negotiable for 16 axle trailers. However, careful consideration of traffic management and escorts will be needed in consultation with both Essex County Council and Essex Police in terms of the final section of the route via the A131 are there will be large sections of the route where the delivery trailer will be requiring the full carriageway width to enable the route to be accessed.

Consideration of the technical requirements for handling components on-site will be required as the scheme progresses in the future.

The report is intended to be a summary of the Abnormal Indivisible Load (AIL) route access at the current time and is not a guarantee that the route will be cleared in the future. Specific movements will need to be assessed at the time on an individual basis. If any further information is required, it is available on request.

1. Introduction

1.1. The contents of this report include land transport feasibility investigations into achieving access to National Grids (NG) proposed Twinstead Substation for Special Order movements of above 150te gross loads associated with the Bramford to Twinstead reinforcement project.

1.2. The weight considered in these investigations is 178te nett which is advised by National Grid to be the weight of the new bulk purchase Sugar Grid Transformer (SGT) required at Bramford approximately in 2023/24.

1.3. This report is a summary of the status of the current AIL access investigations to Twinstead and seeks to present the situation as it currently stands. The issues highlighted in this report as risks to achieving AIL access in the future will need to be revisited and progressed as the scheme develops.

1.4. This investigation considers the possible land transport routes from the port of Tilbury. Formal movement applications will be necessary upon appointment of a haulage contractor by the transformer manufacturer.

1.5. A detailed appraisal of the technical requirements for handling transformers on site will be required as the scheme develops in the future.

1.6. The report is intended to be a summary of the AIL route access at the current time and is not a guarantee that the route will be cleared in the future. Specific movements will need to be assessed at the time on an individual basis. If any further information is required, it is available on request.

1.7. The report considers access to Twinstead Substation in terms of AIL transportation only of the main transformer tank.

2. National Highway Agreement in Principle and Legislative Requirements

2.1. *Definition of Abnormal Indivisible Load (AIL)*

2.1.1. The Department for Transport, of which National Highways (NH), is a government-owned company with responsibility for managing the core road network in England, state that the strict definition of an AIL refers to a load which cannot, without undue expense or risk of damage, be divided into two or more loads for the purpose of carriage on roads and which, owing to its dimensions or weight, cannot be carried on a vehicle which complies in all respects with the 'standard vehicle regulations' these are:

- The Road Vehicles (Construction and Use) Regulations 1986 (as amended)
- The Road Vehicles (Authorised Weight) Regulations 1998 (as amended)
- The Road Vehicles Lighting Regulations 1989 (as amended).

2.1.2. All equipment should be stripped of their ancillaries before they are transported. NH will only accept that further dismantling is not required where it cannot be economically achieved due to the requirement for its construction within specific factory environments or where extremely high tolerances have to be maintained.

2.2. *Legislation*

2.2.1. Conventional heavy goods vehicles have an operating weight limit of 44 tonnes. The category known as abnormal indivisible loads (AIL) covers those vehicles where the gross weight exceeds 44 tonnes. An Abnormal Load is defined as that which cannot be carried under Construction and Use (C&U) Regulations. Items which, when loaded on the load carrying vehicle exceed the weights encompassed by the C&U Regulations, but do not exceed Special Order Permission Limits, are governed by Special Types General Order (STGO) categories 1 to 3 depending on size. Where dimensions exceed 6.1m in width, 30m in rigid length or 150 tonnes gross weight, Special Order from Highways England (HE) is required.

2.2.2. Special Order category AIL movements are authorised by the NH Abnormal Loads team, based in Birmingham. This is further discussed in section 2.3.

2.3. *Water Preferred Policy Requirements*

2.3.1. The Department for Transport has adopted a 'water-preferred' policy for the transport of AILs. This means that, where an application is sought for the movement of a Special Order or VR1 category load (more than 5.0m width) by road, the Department, via NH, will turn down the application where it is feasible for a coastal or inland waterway route to be used instead of road. NH advise that this decision is based on a number of factors including whether the load is divisible, the availability of a suitable route, the amount of traffic congestion that is likely to be caused and the justification for the load to be moved. The HE Abnormal Loads Team is the department responsible for the authorisation of Special Order AIL's and government policy is that the closest available port of access should be used for the delivery of such oversize items.

2.3.2. In consideration of the water-preferred policy to maximise the use of water for the movement of Special Order (Above 150te gross) AIL's wherever practicable, Wynns has sought confirmation from HE as to the port of access they would require to be utilised for the delivery of transformers to Twinstead Substation.

2.3.3. HE have advised (letter dated 05.05.21, AIP reference 784) that Special Order deliveries to Twinstead Substation should be considerate of access from the port of Tilbury.

3. Transport Configurations

3.1. Based on the information available to date the transformer considered within this report is assumed to be 178te nett weight as shown in Drawing Number TL3045-A020A2-RO2.

3.2. Due to the size of the components, it is not possible to transport them under the regulations governing Construction and Use (C&U) vehicles (44 tonne gross, 18.65m long and 2.9m wide). It is also not possible to transport within the Special Types General Order (STGO) regulations as the gross load will be in excess of 150te. It will therefore be necessary to comply with legislation regarding Special Order movements.

3.3. As stated, the movement of abnormal indivisible loads is controlled by the requirements of the Department for Transport (DfT) who stipulate varying notice procedures and notice period's dependent upon overall dimensions.

3.4. Based on information currently available it is assumed that the road transport configuration required for routes from the port of Tilbury would consist of 2 ballast tractors, 1 pulling and 1 pushing a 16 or 20 axle frame trailer with axle loads in the region of 16.5te over a track width of a minimum of 3m.

3.5. There are only three haulage contractors currently operating girder frame trailers of sufficient capacity for the proposed 178te unit in the UK electricity supply industry with equipment able to carry a transformer of this weight and with the knowledge to position the unit correctly on the plinth. These are Allelys Heavy Haulage Ltd, Mammoet and Collett & Sons Heavy Haulage.

3.6. The girder frame trailer arrangements as provided by Colletts, Allelys and Mammoet have been submitted to structural authorities for comment in terms of their suitability on the potential access routes from the port of Tilbury. The trailers to be considered are:

- 16 axle girder frame trailer AL50 at 270te gross weight as provided by Mammoet
- 16 axle girder frame trailer at 264.8te gross weight as provided by Allelys.
- 20 axle girder frame trailer at 312.5te gross weight as provided by Colletts.

3.7. The specific trailer details are not included in this report due to the information being commercially sensitive to each haulage contractor and thus it is recommended it is not forwarded to other parties. However, specific trailer information can be made available to NG under separate cover if required.

3.8. The responses to these investigations are discussed in Section 6.

4. Marine Access

4.1. *Port of Tilbury*

4.1.1. No specific revaluation of marine access at Tilbury has been undertaken as part of this report as it is regularly used for SGT deliveries to the south east for substations in the London area It is available for a variety of heavy lift shipping options and no major issues are expected.

5. Historical Information

5.1. Although the proposed Twinstead Substation is a new site, the proposed AIL route is an extension of that which has been used historically to service Braintree Substation via the M11 and A120. This was most recently proven during 2020 when a SGT of 178 was transported to the substation.

5.2. Wynns were involved with preliminary planning for this movement in 2016 and this included the need of the then Highway England Area 6 (Atkins), who are now National Highways East Region, to assess Hallingbury Hall Bridge on the M11. Hallingbury Hall Bridge is between Junctions 7 and 8 of the M11 at approx. OS Ref TL 5090 1650 and was assessed in 2016 in preparation for the 2020 SGT delivery to Braintree Substation for a nett load of 169.7te.

5.3. In addition, various sites were considered during the 2009-2012 works in the area south west of Sudbury for the new substation location before the site known as Twinstead at Butlers Wood, adjacent to the A131 at Approximate OS Grid reference TL 8470 3740 was identified. This was the preferred location from an AIL transport perspective for the delivery of transformers in 2012.

5.4. The 2009 works required that structural assessments were carried out based on a nett transformer transport weight of 137te and positive results were obtained at that time from Essex County Council (ECC). The 3 particular structures which needed to be assessed by ECC's consulting engineers (Mouchel) for transport configurations based on 137te nett transformers are as detailed below.

- Ossieres Bridge No.1449 (River Blackwater at OS Ref TL 7780 2430)
- Bourne Brook No.42 (OS Ref TL 7990 2890)
- Town Bridge No.43 (River Colne Bridge at OS Ref TL 8110 3050)

5.5. The 2012 works reconsidered access for an increased weight of 169.7te nett and ECC advised that one specific trailer arrangement was acceptable on all of the structures. They advised that the other trailers would probably be acceptable but would require further detailed checks prior to agreement.

5.6. The negotiability of the route was proven for 16 axle girder frame trailers following topographical surveys and Swept Path Assessments (SPA) at the three A131 bends between the A1017 junction and Halstead near Bournebridge Hill.

6. Structural Route Information

6.1. The route considered to the proposed Twinstead Substation from Tilbury is detailed below.

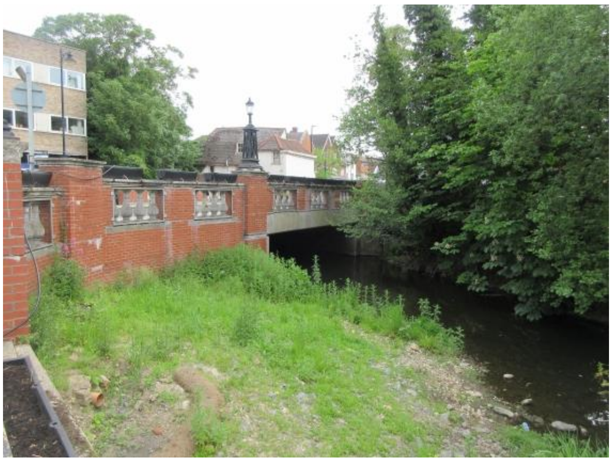
- Exit Tilbury Docks
- Turn left A126 St Andrews Rd/A1089 Dock Approach Road
- Turn left A13
- At M25 Junction 30 turn right and continue M25 anticlockwise
- At Junction 29 use exit and entry slip roads to avoid Cobham Hall Viaduct
- Continue M25 to Junction 27
- Exit M25 Junction 27 taking slip road to M11 northbound
- Exit M11 junction 8
- *(Note: Both the old M11 Jct 8 access via the roundabout and the new junction slip road link are considered negotiable. NH East Region to advise on preferred route through junction to main A120 eastbound)*
- Turn right new A120 Braintree Bypass
- At Coggershall Road roundabout continue A131
- Turn right A131 Broad Road
- At High Garret turn right A131 Halstead Road
- Continue A131 via Halstead to approx OS Reference TL 8470 3740 where new access roads to the proposed Butlers Wood site locations would be proposed.

6.2. National Highways East Region has advised that the 20 axle is not presently able to be cleared on the M11 motorway at Hallingbury Hall Bridge. The 16 axle trailers have been advised as acceptable on the proposed route. As stated above it should be noted that the bridge was crossed with a Hyundai 178te transformer in 2020. Therefore the route has only been cleared on 16 axle trailers. This is not considered an issue, as there are benefits in using the smaller 16 axle trailers in terms of route negotiability as detailed in Section 7.

6.3. Essex County Council required that the A131 Town Bridge in Halstead was assessed in order to confirm its suitability for the proposed loads which are at 178te nett transformer weight in excess of the 169.7te weight used in the previous route clearance works. This has been undertaken by the third party consulting engineers Wallace Stone and the bridge has been deemed as acceptable to all trailer arrangements. Final written confirmation remains outstanding from Essex County Council in terms of agreeing the final check certificates but no major issues are expected.

Photograph 1

A131 Town Bridge Street in Halstead. Vehicle approaches camera. Structural assessment confirms it is suitable for all trailers included in assessment.



Photograph 2

A131 Town Bridge Street in Halstead. Vehicle approaches camera. Structural assessment confirms it is suitable for all trailers included in assessment.

Photograph 3

A131 Town Bridge Street in Halstead. Vehicle approaches camera. Structural assessment confirms it is suitable for all trailers included in assessment.

6.4. Essex Police advised that the movement(s) will require a major police presence to achieve the necessary road closures. All Essex Police costs will be recovered from the appointed haulier. They have advised that ECC will have the final say on what is acceptable or not on Town Bridge and will be happy to discuss the route once the route has been agreed by NH and ECC and once the full dimensions of the loads are confirmed in order for them to confirm how many police resources will be required and for how long, together with costs. In short no major issues have been identified other than the need for sufficient planning and time to be allowed for to agree escort requirements, movement times and costs etc.

7. Route Negotiability Information

7.1. The route survey was undertaken in June 2021 from the M11 junction 8 to site. Access from the M11 via the A120 to the A131 is negotiable and as far as Braintree and is proven for 16 axle trailers transporting SGTs to Braintree Substation. The final approach from the A120/131 junction to the proposed site is described below.

Photograph 4

A131/B1053 roundabout north of Braintree. Load approaches from left and exits behind camera. Negotiable.

7.2. The A131 from Braintree to Halstead is considered negotiable for the proposed loads. However, there will be a need for the appointed haulage contractor to agree exact escort and traffic management requirements with the police as there will be sections of the A131 where the AIL will require to utilise the full width of the carriageway including crossing over solid white lines. Further discussion of road closure requirements would be necessary with ECC and the police to confirm traffic management requirements. It may be required to formally process temporary road closures by way of Temporary Traffic Regulation Orders (TRO's) made under the Road Traffic Regulation Act 1984 by the highway authority to support any enforceable traffic or highways measures.

7.3. There are also areas where tree pruning may be necessary depending on growth at the time of movement. Example photographs of typical locations are shown below.

Photograph 5
A131 north of Braintree. Load moves away from camera. Possible layup area to relieve traffic congestion subject to approval from ECC and Essex Police.

Photograph 6
A131 north of Braintree at High Garrett. Load moves away from camera. Street furniture removal required.

Photograph 7
A131 north of Braintree at High Garrett. Load moves away from camera. Street furniture removal required. Caution with overhead wires.

Photograph 8
A131/A1071 junction. Load moves away from camera bearing right. Negotiable.

Photograph 9
A131/A1071 junction. Load moves away from camera bearing right. Negotiable.

Photograph 10

A131 south of Halstead at OS Ref TL 7934 2837. Vehicle moves away from camera. Negotiable for 16 axle girder frame trailers. Example of where full road width will be required under police escort with consideration of traffic management. If 20 axle trailers are proposed then additional Swept Path Assessments (SPA) will be necessary.

Photograph 11

A131 south of Halstead at OS Ref TL 7934 2837. Vehicle approaches camera. Negotiable for 16 axle girder frame trailers. Example of where full road width will be required under police escort with consideration of traffic management. If 20 axle trailers are proposed, then additional Swept Path Assessments (SPA) will be necessary.

7.4. The right bend south of Halstead at OS Ref TL 7934 2837 was surveyed and Swept Path Assessment (SPA) undertaken during 2012 works for a 14 axle girder frame trailer considerate of a 169.7te SGT. This confirmed that access was feasible with some oversail on the inside of the bend within the public highway as shown in Figure 2 below. In the event that a 20 axle trailer is proposed it would be recommended that the SPA is revisited to confirm it is negotiable for the larger trailer. Due to 20 axle trailers being rejected on M11 this is not needed at this time.

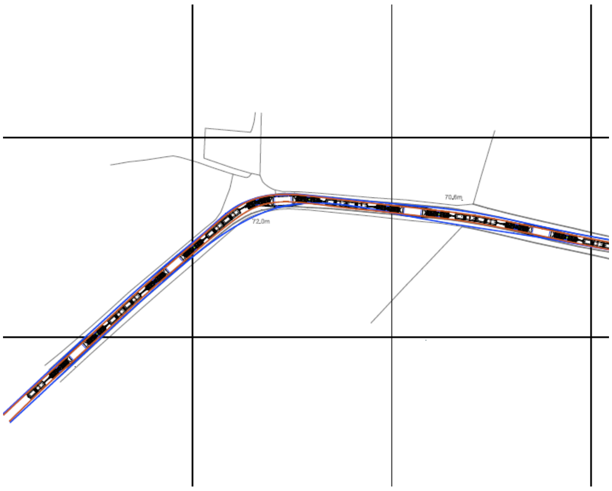


Figure 1.
A131 right bend south of Halstead at OS Ref TL 7934 2837. Extract from 2012 Drawing Number NG-NSS-SPA02 Sheet 1 confirming access for 14 axle trailer.

Photograph 12
A131 south of Halstead. Vehicle moves away from camera. Negotiable. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 13
A131 south of Halstead. Vehicle moves away from camera. Negotiable for 16 axle trailers. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 14
A131 south of Halstead at OS Ref TL 7965 2832. Vehicle moves away from camera. Negotiable for 16 axle girder frame trailers. Example of where full road width will be required under police escort with consideration of traffic management. If 20 axle trailers are proposed then additional Swept Path Assessments (SPA) will be necessary.

7.5. The left bend south of Halstead at OS Ref TL 7965 2832 was surveyed and Swept Path Assessment (SPA) undertaken during 2012 works for a 14 axle girder frame trailer considerate of a 169.7te SGT. This confirmed that access was feasible with some oversail on the inside of the bend within the public highway as shown in Figure 3 below. In the event that a 20 axle trailer is proposed it would be recommended that the SPA is revisited to confirm access for the larger trailer. Due to 20 axle trailers being rejected on M11 this is not needed at this time.

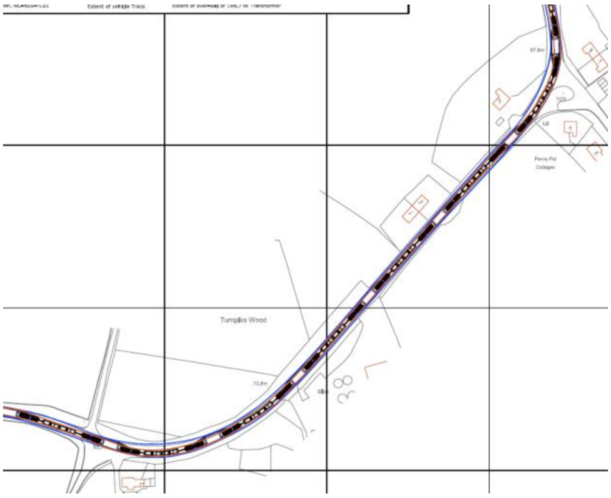


Figure 2.
A131 left bend south of Halstead at OS Ref TL 7965 2832. Extract from 2012 Drawing Number NG-NSS-SPA02 Sheet 2 confirming access for 14 axle trailer.

Photograph 15

A131 south of Halstead at OS Ref TL 7991 2851. Vehicle moves away from camera. Negotiable for 16 axle girder frame trailers. Example of where full road width will be required under police escort with consideration of traffic management. If 20 axle trailers are proposed, then additional Swept Path Assessments (SPA) will be necessary. Also shown in above extract from 2012 Drawing Number NG-NSS-SPA02 Sheet 2 confirming access for 14 axle trailer.

Photograph 16

A131 south of Halstead. Vehicle moves away from camera. Negotiable for 16 axle girder frame trailers. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 17
A131 south of Halstead at OS Ref TL 7986 2876. Vehicle moves away from camera. Negotiable for 16 axle girder frame trailers. Example of where full road width will be required under police escort with consideration of traffic management. If 20 axle trailers are proposed, then additional Swept Path Assessments (SPA) will be necessary. Extract from 2012 Drawing Number NG-NSS-SPA02 Sheet 3 confirming access for 14 axle trailer.

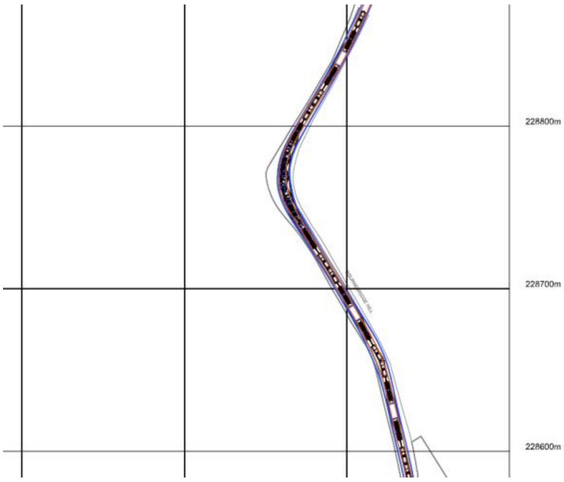


Figure 3.
A131 right bend south of Halstead at OS Ref TL 7986 2876. Extract from 2012 Drawing Number NG-NSS-SPA02 Sheet 3 confirming access for 14 axle trailer.

Photograph 18

A131 south of Halstead. Vehicle moves away from camera. Negotiable for 16 axle girder frame trailers. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 19

A131 south of Halstead. Negotiable for 16 axle girder frame trailers. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 20

A131 south of Halstead. Negotiable for 16 axle girder frame trailers. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 21

A131 south of Halstead. Negotiable for 16 axle girder frame trailers. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 22

A131 south of Halstead. Negotiable for 16 axle girder frame trailers. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 23

A131 on approach to Halstead. Vehicle moves away from camera. Street furniture removal required.

Photograph 24
A131 on approach to Halstead. Vehicle moves away from camera. Street furniture removal required.

Photograph 25
A131 on approach to Halstead. Vehicle moves away from camera. Street furniture removal required.

Photograph 26
A131 in Halstead. Vehicle moves away from camera. Negotiable. Caution with overhead wires needed on entire route but not a significant restriction.

Photograph 27
A131 Trinity Street/Bridge Street right bend in Halstead. Vehicle moves away from camera. Negotiable for 16 and 20 axle girder frame trailers with full occupation of the carriageway. Detailed consideration of traffic management required for access at this location and throughout Halstead town centre where the full road width will be required under police escort.

Photograph 28
A131 Bridge Street/High Street left bend in Halstead approaching Town Bridge. Vehicle moves away from camera. Negotiable for 16 and 20 axle girder frame trailers with full occupation of the carriageway. Detailed consideration of traffic management required for access at this location and throughout Halstead town centre where the full road width will be required under police escort.

7.6. As detailed in Section 6, Town Bridge has been assessed and is advised as able to accommodate all of the proposed loaded trailer arrangements.

Photograph 29
A131 Town Bridge. Vehicle moves away from camera. Negotiable although consideration of traffic management on Halstead High Street is required.

Photograph 30
A131 Halstead High Street. Vehicle moves away from camera. Negotiable. Consideration of traffic management on Halstead High Street is required in consultation with Essex Police.

Photograph 31
A131 Halstead High Street. Vehicle moves away from camera. Negotiable. Consideration of traffic management on Halstead High Street is required in consultation with Essex Police.

Photograph 32

A131 north of Halstead. Vehicle moves away from camera. Negotiable. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 33

A131 north of Halstead. Vehicle moves away from camera. Negotiable. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

Photograph 34

A131 north of Halstead. Vehicle moves away from camera. Negotiable. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required. Caution with overhead wires.

Photograph 35
A131 north of Halstead. Vehicle moves away from camera. Negotiable. Example of where full road width will be required under police escort with consideration of traffic management. Tree pruning may also be required.

7.6.1. This A131 then continues to the new proposed site access location that is to be developed by National Grid. No issues with access expected as long as site access is designed to be considerate of loaded trailer arrangements.

Photograph 36
A131 at approximate site access point for new Twinstead Substation where new access road is to be constructed considerate of SGT delivery vehicle. Vehicle moves away from camera and turns left into new access road.

7.6.2. Wynns undertook an initial review of the proposed substation access road design in June 2022 and this recommended that the bell mouth be expected to account for the possible use of 20 axle girder frame trailer. This drawing, number 21-1030.SPA24, is included in Appendix 2 for information. Whilst this size trailer is presently not advised as structurally suitable on the M11 motorway it does present a reasonable worst case in terms of negotiability for the site access.

8. Summary and Conclusions

8.1. The NH Abnormal Loads Team has provided Agreement in Principle (AIP) for Twinstead Substation and have stated that their preference is for access to be via Port of Tilbury.

8.2. Tilbury remains suitable for the shipment of the transformers via various methods of offloading.

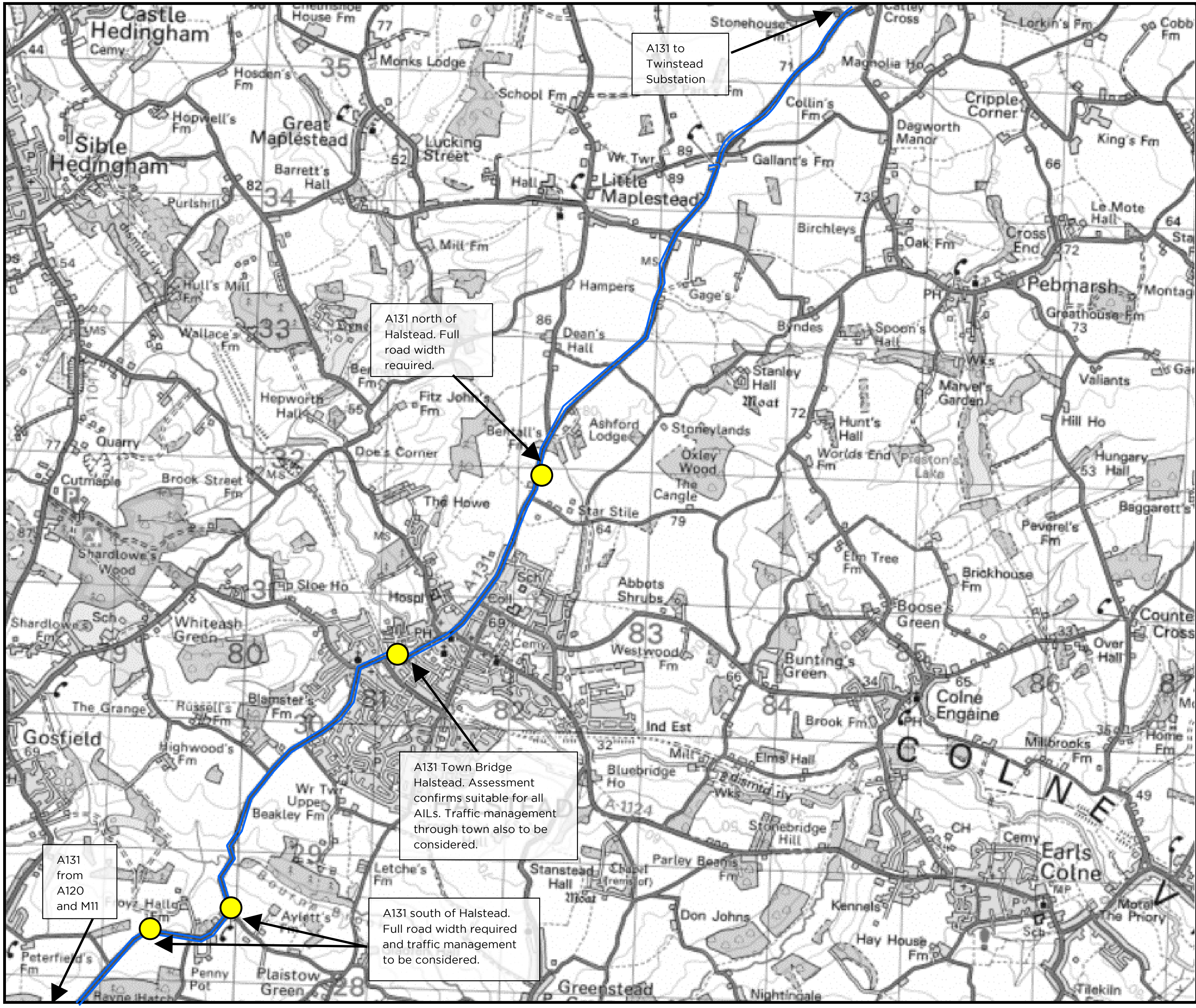
8.3. The proposed route from Tilbury has been structurally cleared on 16 axle girder frame trailers. 20 axle trailers have presently not been advised as suitable on the M11 motorway by NH East Region.

8.4. The route from Tilbury is considered negotiable subject to the removal of street furniture for 16 axle trailers although and careful consideration of traffic management on the A131 will be required subject to agreement with Essex Police and ECC and early engagement with these authorities should be entered into by the appointed haulage contractor to confirm the exact movement planning requirements.

8.5. No specific consideration has been given to onsite access requirements within the new substation compound.

Appendix 1

Maps



Key

(blue line)	Proposed AIL Route to Twinstead
(yellow circle)	Point of Interest

Rev	Date	Amendments:
B		
A		
0	06.12.22	First Issue

Revisions

Wynns Ltd. Independent Transportation Engineers

Shaftesbury House, 2 High Street, Eccleshall, Stafford, ST21 6BZ. Tel: (01785) 850411

Client: nationalgrid

Project: 21-1030 Bramford to Twinstead

Title: Map 1 – AIL Access for SGT to Twinstead

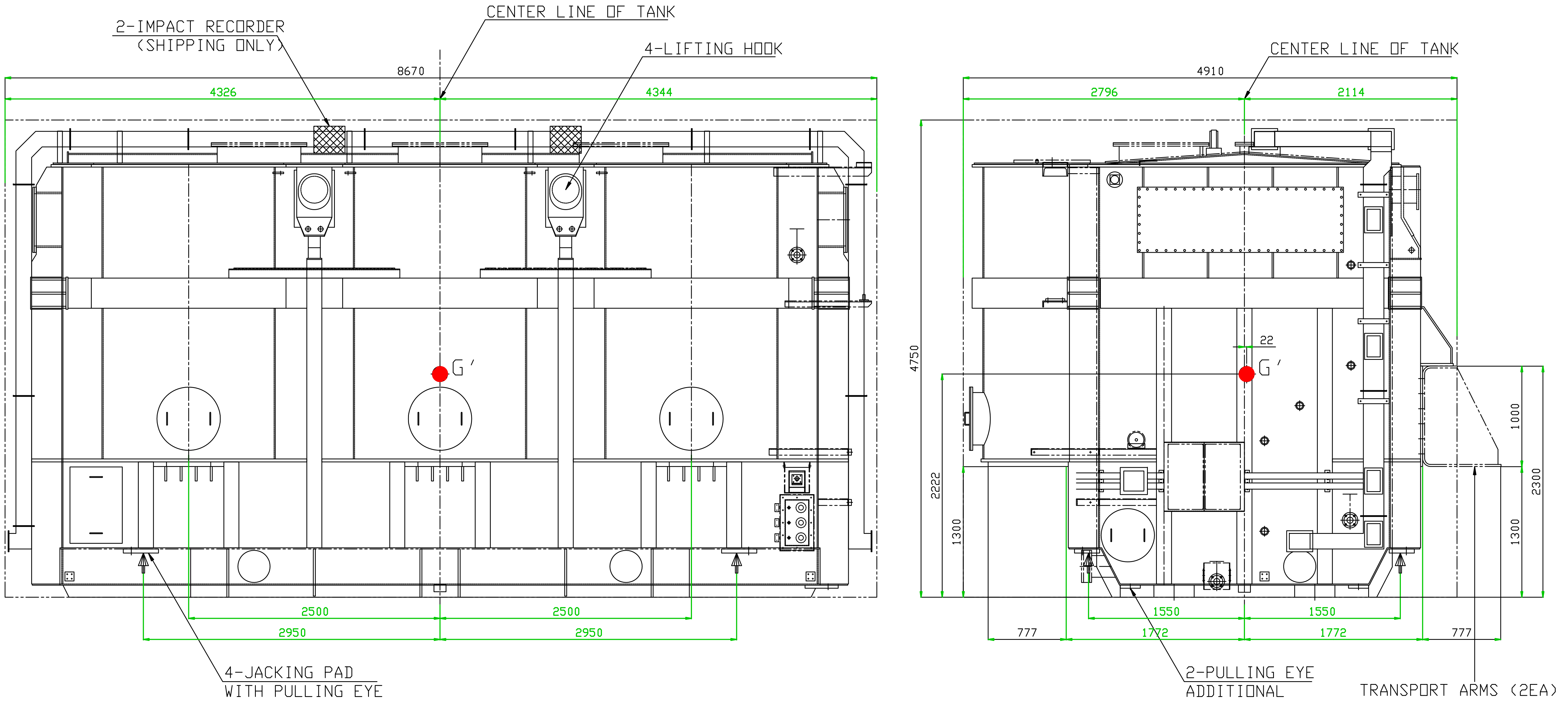
Drawing Status: Final Report

Scale (A4):	Drawn by:	Checked by:
NTS	HW	ARP

Ref No.:	Sheet:	Rev.:
21-1030 SGT	1 of 1	0

Appendix 2

Drawings

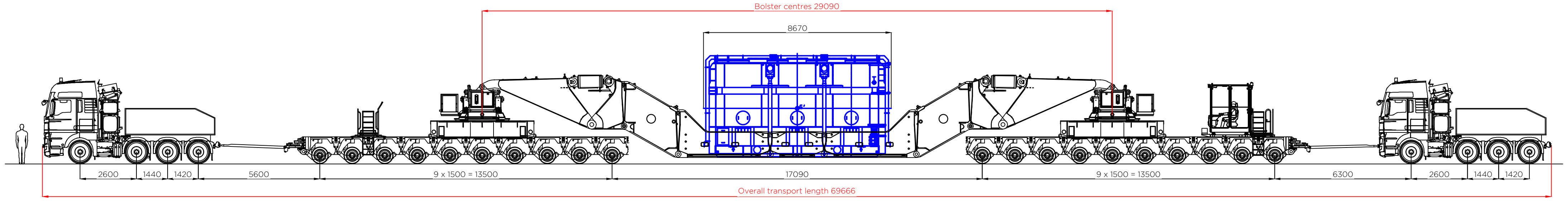


SHIPPING(MAIN BODY)	
DIMENSION	SIZE L8670xW4910xH4750
WEIGHT(WITHOUT OIL)	178000 KG

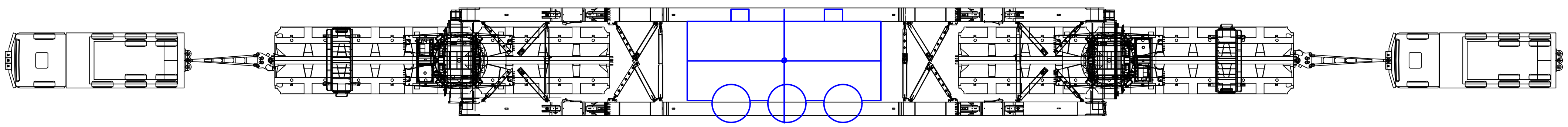
※ NOTE
TRANSPORT ARMS WILL BE DETACHED AND SEPERATELY SHIPPED.

Customer: nationalgrid				Site : SEABANK 400kV SUBSTATION SGT1 T-NUMBER : T7430	
Contractor: HYUNDAI ELECTRIC				Title : SHIPPING DRAWING OF TRANSFORMER MAIN BODY 400/132KV SUPERGRID TRANSFORMER-TYPE TL3045	
Contract No.	-			Contractor Project No.	20170844TLF007
Date	2017.04.25	Unit	mm	Contractor Drawing No.	TL3045-A02
Desinged	Checked	Approved	Scale 1:30	NG Drawing No.	-
J.H.PARK	J.K.KIM	I.R.CHOI	Size A2	Sheet 1 / 1	Revision. 2

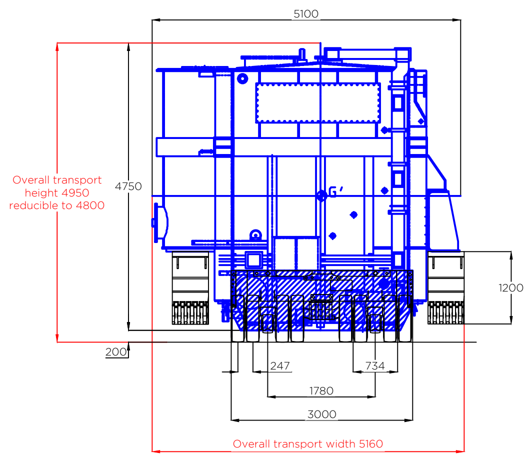
		Rev.	Description			Rev.	Description
APP	2017.06.29 J.K.KIM	1	1.REVISION BY COMMENTS	APP	2018.01.10 J.K.KIM	2	1.CHANGED SHIPPING WEIGHT (174.1ton -> 178ton)
CHK	2017.06.29 C.Y.CHOI			CHK	2018.01.10 C.Y.CHOI		
DSN	2017.06.29 J.H.PARK			DSN	2018.01.10 J.H.PARK		



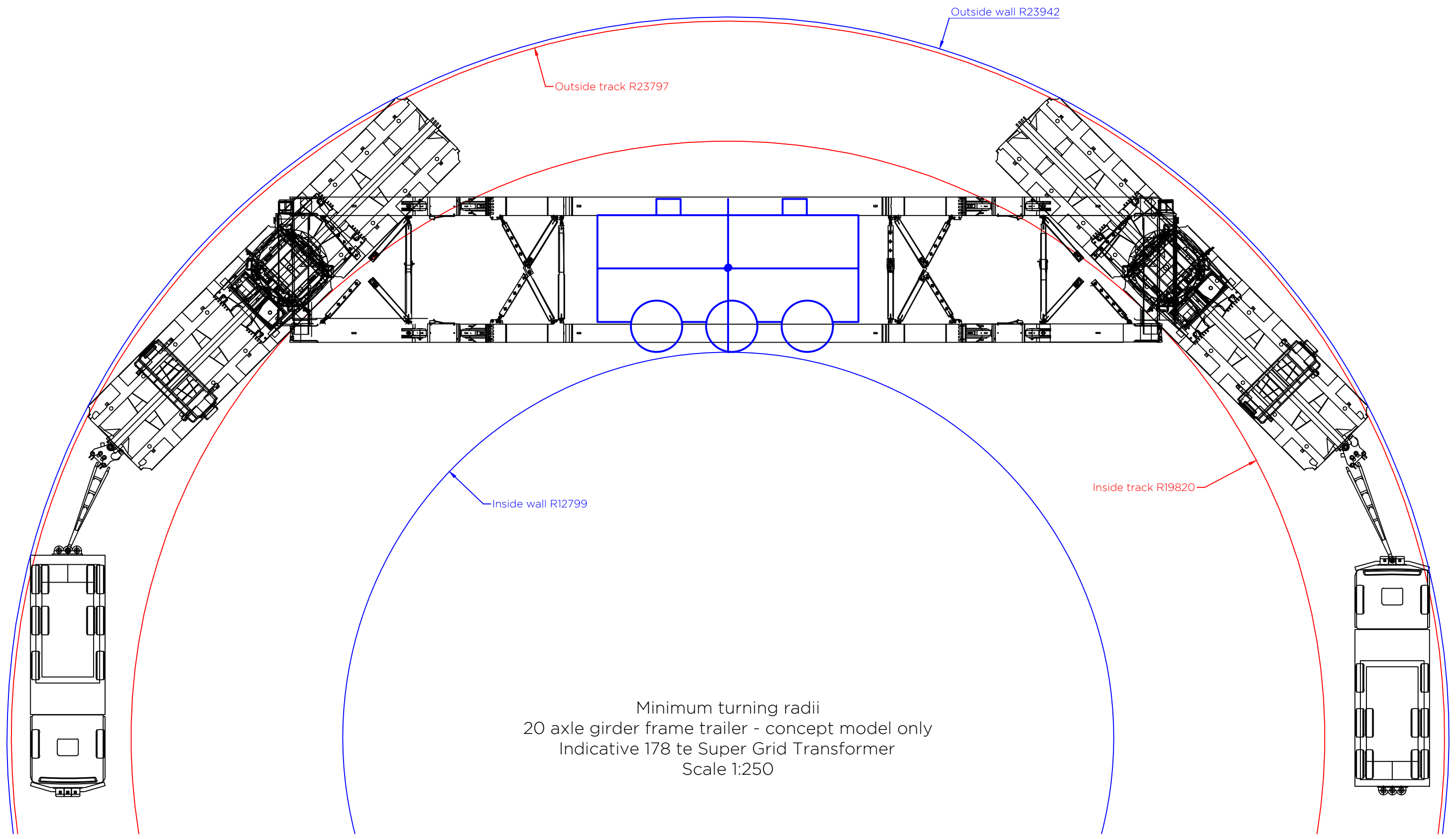
Elevation view - 20 axle girder frame trailer - concept model only
Indicative 178 te transformer
Scale 1:250



Plan view - 20 axle girder frame trailer - concept model only
Indicative 178 te transformer
Scale 1:250



Profile view
Scale 1:125



Minimum turning radii
20 axle girder frame trailer - concept model only
Indicative 178 te Super Grid Transformer
Scale 1:250

Load table

20 axle girder frame trailer	
Self weight of transformer	178.0 te
Self weight of trailer	134.0 te
Self weight of aux. steelwork (for L&S)	0.0 te
Total combined weight	312.5 te
Load per trailer	156.25 te
Load per axle line	15.63 te
Load per axle	7.81 te
Load per wheel (4 per axle)	1.95 te
Overall ground bearing pressure	3.86 te/m²

Tractor(s) (42 te)	
Front axle	7.0 te
Second steer	8.0 te
Rear axle	13.5 te
Rear axle	13.5 te

Notes:

[1] The figures shown above are representative of the transport configuration portrayed. However, as tractor and trailer arrangements vary then the loads and dimensions indicated should be treated as probable values.

[2] Actual dimensions, including axle spacing and mean running height, may vary slightly depending on manufacturer of trailer deployed.

[3] All linear measures in millimetres unless stated otherwise.

[4] Consideration to be given to transformer overhang due to offset COG. Overhang shown to nearside of trailer on this drawing, however, haulier to confirm, taking into account route negotiability, and configure to suit.

Rev.	Date	Amendments
1		
0	07.06.22	Issued for comment

Revisions

Prepared by:

WYNNS Independent Transportation Engineers
Shaftesbury House, 2 High Street, Eccleshall, Stafford, ST21 6BZ
Tel: (01785) 850411
Independent Transportation Engineers

Client:
nationalgrid

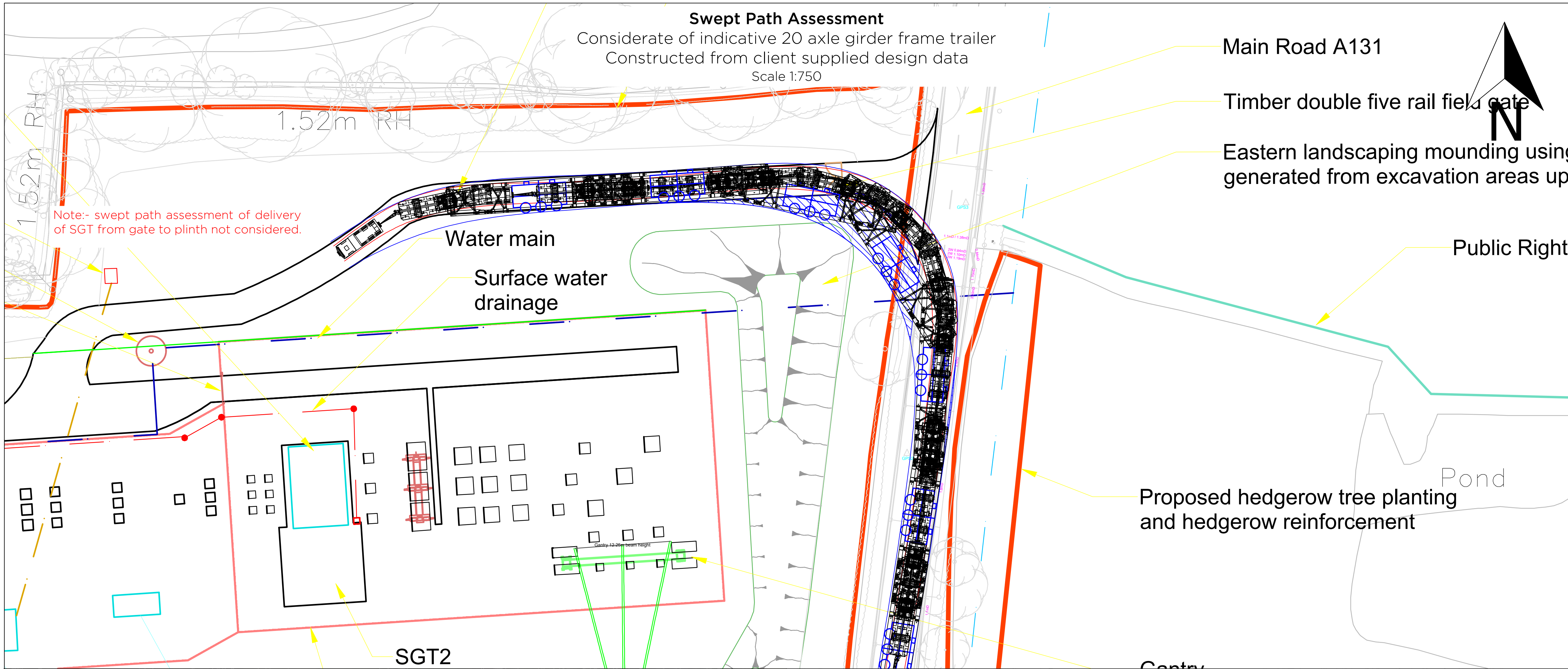
Project:
Bramford to Twinstead Substation

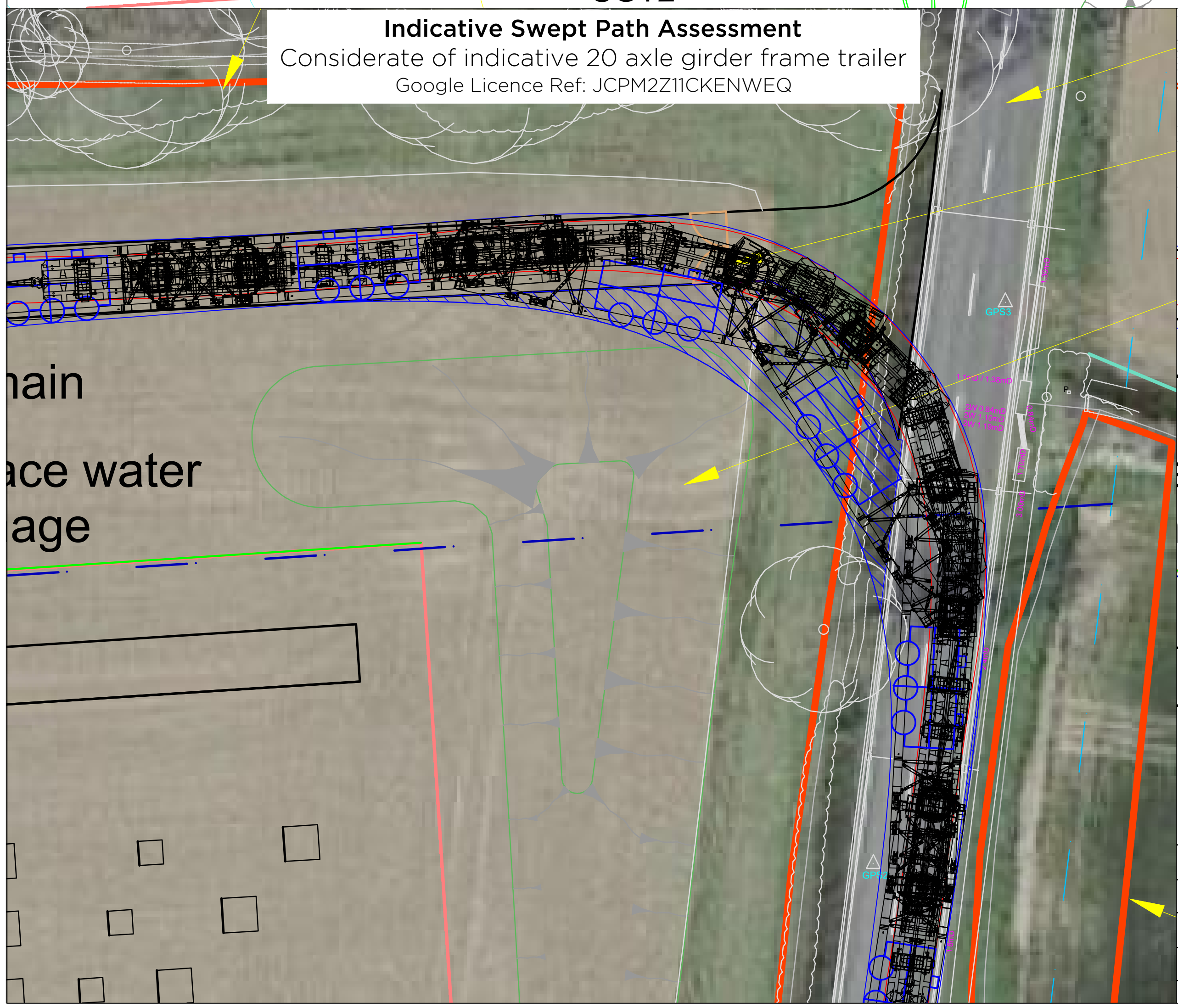
Title:
Indicative transport configuration
Conceptual 178 te transformer carried within 20 axle girder frame trailer showing minimum turning radii

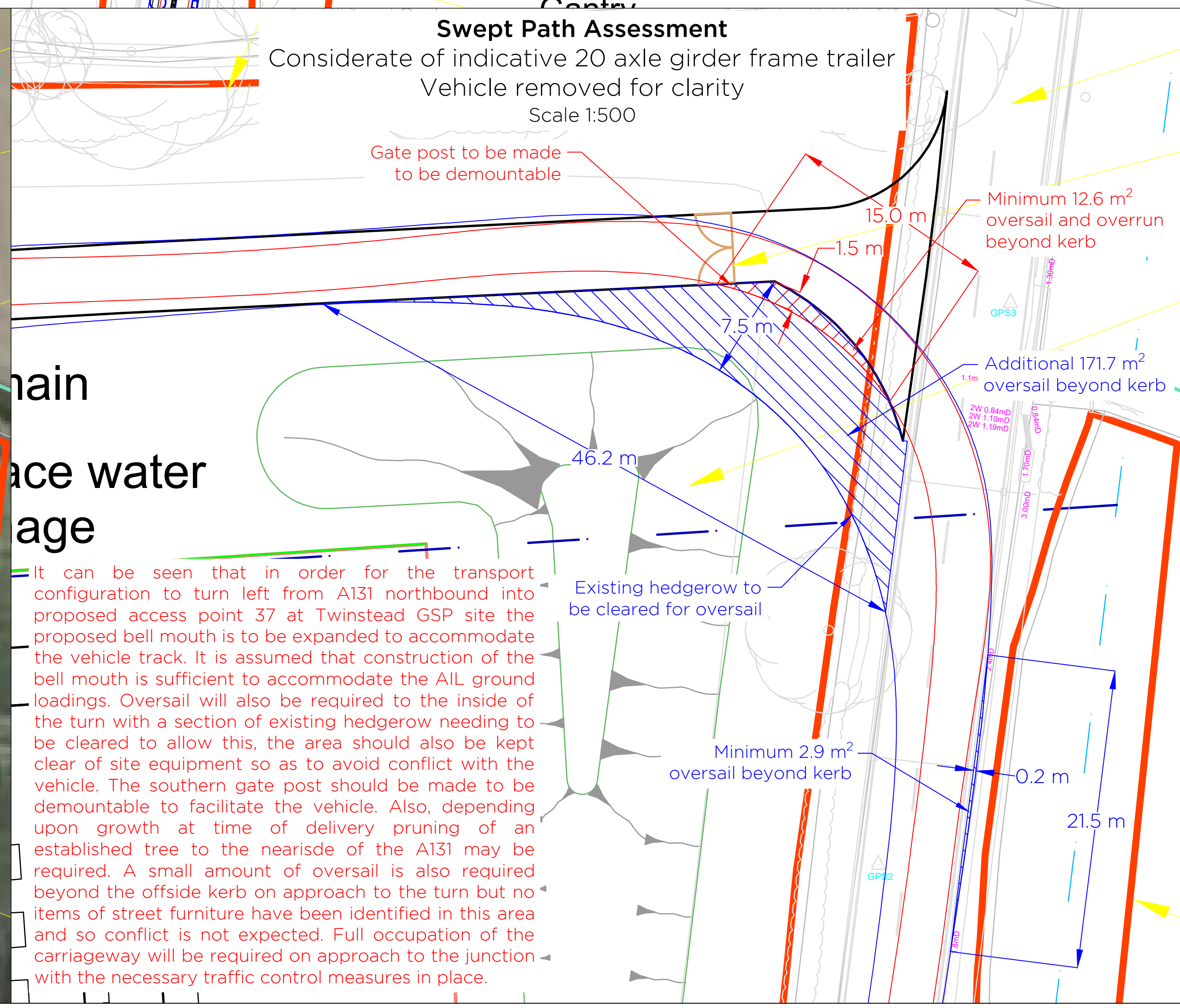
Drawing status:
Final report

Scale (A3):	Drawn By:	Checked By:
As shown	SJW	ARP
Dwg. no:	Sheet:	Rev:
21-1030.TC06	1 of 1	0

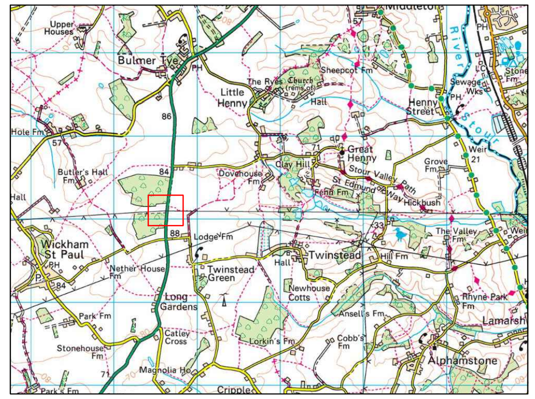
P:\Clients\Existing Clients\National Grid Company\Proposed New sites Investigations\21-1030 Bramford to Twinstead\Transport configuration\21-1030.TC06 Bramford to Twinstead 178 te SGT 20 axle girder frame R0.dwg







Location Plan



Legend:

- 20 axle girder frame trailer minimum turning arrangements Drawing ref. 21-1030.TC06
- Extent of vehicle track
- Extent of oversail
- Overrun and oversail beyond kerb
- Overrun beyond kerb
- Oversail beyond kerb

Rev.	Date	Amendments
1		
0	08.06.22	Issued for comment

Revisions

Prepared by:

WYNNS
Shaftesbury House, 2 High Street, Eccleshall, Stafford, ST21 6BZ
Tel: (01785) 850411
Independent Transportation Engineers

Client: nationalgrid

Project: **Bramford to Twinstead**

Title: **Swept Path Assessment**
Negotiability of left turn from A131 northbound into proposed access point 37 at Twinstead GSP site considerate of indicative 178 te Super Grid Transformer transported on 20 axle girder frame trailer
Approximate OS Grid Reference TL 846 371

Drawing status: Final report

Scale (A3):	Drawn by:	Checked by:
As shown	SJW	ARP
Dwg. no: 21-1030.SPA24	Sheet: 1 of 1	Rev: 0

P:\Clients\Existing Clients\National Grid Company\Proposed New sites Investigations\21-1030 Bramford to Twinstead\Vehicle tracking\21-1030.SPA24 Bramford to Twinstead A131 AP37 GSP 178 te SGT 20 axle girder frame R0.dwg

Appendix 3

National Highways Correspondence

highways england

Our ref: HE Ref AIP 784
Your ref: Twinstead Substation, Butlers Wood

Andy Pearce
Wynns Limited
Shaftesbury House
High Street
Eccleshall
Staffordshire
ST21 6BZ

Laura Blundell
Senior Route Planner
9th Floor
The Cube
199 Wharfside Street
Birmingham B1 1RN

5 May 2021

Dear Andy,

AGREEMENT IN PRINCIPLE: - AIP 784 TWINSTEAD SUBSTATION, BULTERS WOOD

Thank you for your email dated 29 April 2021, requesting provision of an AIP for future abnormal load moves into the Twinstead Substation.

I can confirm that an AIP can be provided for the movement of one Transformer from Tilbury to Twinstead Substation, Butlers Wood.

This will of course be subject to formal application nearer the time at which Highways England will consult with all relevant parties and take into consideration their views and requirements. Consequently, any Special Order issued is likely to include specific requirements relating to the day(s) on which movements will be authorised. The Special Order may also prescribe specific times during the day or night when movement will be permitted (which may take into account seasonal variations in traffic) in order to minimise traffic congestion, and disruption to other road users.

This agreement in principle is valid for a period of at least seven years but with the proviso that should a nearer, suitable access become apparent, or feasible in that time, National Grid would undertake to investigate and assess its potential for future use, with a view to that new facility becoming the agreed access.

It would be helpful if you could ask the designated haulage contractor to quote the above AIP reference when applying for the VR1 and Special Order permits.

I trust this information is sufficient for your purposes, but please do not hesitate to get in touch if you require anything further.

Yours sincerely

Laura Blundell

Laura Blundell
Senior Route Planner
Abnormal Indivisible Loads Team
Email: [redacted]
Direct Line: [redacted]

INVESTORS IN PEOPLE

Andy Pearce

From: Hyde, Nicolas [redacted]
Sent: 17 May 2021 11:15
To: Andy Pearce
Cc: Hollender, Sarah
Subject: RE: catch up on applications

Hi Andy

Just spoken to Sarah and passed on your best wishes, she said thank you. She is feeling much better so should be returning to work on Wednesday all being well.

Looks like we are just waiting for The East Region for the two you mention below, Norwich and Biggleswade. Just received the below email from the East accepting Twinstead (WYNL/40) for the 16 axle vehicles only. Still waiting for Connect Plus and Essex CC on that one.

Sarah will update in more detail on the others on Wednesday.

WYNL/40 - I can confirm that the proposed movement is authorised subject to the following caveats:

- *The proposed vehicle should be the 16 Axle Girder Frame Trailer AL50 (270te) or 16 Axle Girder Frame Trailer (264.8te)* ***and not 20 Axle Girder Frame Trailer (312.5te).***
- *The overall height of the load should not exceed 5m (Tractor , trailer and load).*
- *All other abnormal load movement protocols should be adhered to.*

Special Inspections (SI) would be carried out after the load movement on the structures listed below.

- *Pickpocket Underbridge (Structure key- 23415)*
- *Motts Green Culvert (Structure key 3050)*
- *Goose Lane Culvert (Structure key 3052)*
- *Pincey Brook Culvert (Structure key 24263)*
- *River Roding Culvert (Structure key 24267)*
- *Birchanger Brook Culvert (Structure key 23052)*

Thanks
Nick

From: Andy Pearce [mailto:[redacted]
Sent: 17 May 2021 09:41
To: Hyde, Nicolas [redacted]>
Subject: RE: catch up on applications

Nick,

So sorry to hear that, please pass my best onto her wishing her a speedy recovery. That is much more important than my nonsense.

Appendix 4

A131 Town Bridge Information

WYNNS LTD

TWINSTEAD SUBSTATION AIL ACCESS
BRIDGE ASSESSMENT

A131 TOWN BRIDGE, HALSTEAD
(43/42624)

National Grid
per Wynns Ltd
Shaftesbury House
High Street
Eccleshall
Staffordshire
ST21 6BZ

Tel: 01785 850411

Wallace Stone
Suite 21
Templeton House
62 Templeton Street
Glasgow
G40 1DA

Tel: 0141 554 8233
Fax: 0141 554 4727

September 2022

Doc Ref – 2405/Doc/001

Member of the Association
for Consultancy and Engineering

This document was prepared as follows:-

	Name	**Signature**	**Date**
Prepared By	R Donnet	[redacted]	September 2022
Checked By	N Greenwood	[redacted]	September 2022
Approved By	G Brown	[redacted]	September 2022

and revised as follows:

REVISION STATUS INDICATOR

Page No	**Date**	**Revision**	**Description of Change**	**Initial**

This document has been reviewed for compliance with project requirements in accordance with Wallace Stone LLP Quality Management System.

Wallace Stone

WYNNS LTD
TWINSTEAD SUBSTATION AIL ACCESS
BRIDGE ASSESSMENT

A131 TOWN BRIDGE
(43/42624)

CONTENTS

Page

APPENDICES

WYNNS LTD
TWINSTEAD SUBSTATION AIL ACCESS
BRIDGE ASSESSMENTS

A131 TOWN BRIDGE
(43/42624)

1. INTRODUCTION

Wynns has been appointed by National Grid to examine the feasibility of an access route for delivery of a transformer to a new substation location at Twinstead in Essex. As part of this exercise a bridge assessment is required on a bridge on the A131 in Halstead to check the capacity for the possible abnormal loads carrying 178 tonne gross weight transformer, carried by multi axle trailers. The proposed vehicles are considered as Abnormal Indivisible Loads (AIL).

Wynns has appointed Wallace Stone to carry out the assessment of the structure (Structure ref. 43/42624 A131 Town Bridge, Halstead). Details of the structure can be found in Section 2.

An inspection for assessment was carried out on 9th May 2022 by a chartered civil engineer and graduate civil engineer. The weather at the time of inspection was sunny and calm.

2. DESCRIPTION OF STRUCTURE

The details of the structure are as shown in the Table below.

Ref; name	43/42624 A131 Town Bridge
Grid Ref	TL 81229 30507
Type	Single skew span simply supported concrete bridge. Bridge deck comprises precast prestressed beams with insitu concrete infill slab.
Spans; skew	8.57m clear skew span between bearing centres (7.725m square) with 26° skew
Deck Slab	Under carriageway – 480mm deep comprising 380mm deep T1 beams (20 No.) with 100mm top slab. Under footway – 610 deep comprising 535mm deep T3 beams (2 No. each footway) with 75mm top slab.
Abutments	The deck is supported on an RC U-frame consisting of abutment walls and connecting base slab with the base slab acting as a spread foundation
Carriageway width	Single carriageway approximately 8.5m wide
Footway width	South and north footways average 2.887m and 2.91m respectively
Surfacing depth	90mm surfacing overlaid on 100mm concrete fill
Obstacle crossed	River Colne
Date of construction	Circa 1979

3. INSPECTION FOR ASSESSMENT

A Principal Inspection Report dated 2021 was provided by Essex County Council and used as a comparison for any changes in condition.

The inspection for assessment was carried out on the 9th May 2022 from the top at road level and from the adjacent land to the north and south of the bridge. Full access below the structure was not achieved due to water level and softness of the riverbed.

There was no change to the condition of the structure observed since the previous Principal Inspection in 2021. The structure is generally in a good condition with no defects noted which could reduce the structure's load capacity to carry the abnormal indivisible loads. A Condition Factor of 1.0 is applicable for all deck elements.

4. ASSESSMENT INFORMATION

A previous assessment report was provided by Essex County Council. This was carried out in 2010 for a previous abnormal load movement programme. The assessment investigated the possible transportation of a 137 Tonnes net weight transformer.

Drawings were also provided by Essex County Council for this structure, as noted in the AIP. These showed the general layout, cross-sections, and details of prestressed main beams, footway beams and reinforced concrete footway slab and parapet beams. Dimensional information given on the drawings was confirmed during the site inspection as far as possible.

The structure has been assessed for the range of vehicles noted in the AIP and summarised in Section 5. Standards and references used were as noted in Annex A to the AIP.

Material properties given on the drawings were:

Element	Material	Strength (MPa)
slab	Prestressed concrete	f_{cu} = 52.5
	Prestressed concrete (transfer)	f_{cu} = 40
	In situ concrete	f_{cu} = 45
	Reinforcement	f_y = 410 (high yield)
	Prestressing tendons	f_{pu} = 1751 (12.7mm ø – 7 wire strand)

AIP for assessment was submitted to Essex County Council on 1st June 2022, and accepted on 7th July 2022. The AIP is found in Appendix B. Assessment and check certificates were accepted by Essex County Council on ???????? and can be found in Appendix C.

5. ASSESSMENT

5.1 Vehicle Details

The vehicles considered for the Transformer movement are as below:-

Transformer - Collett 20 axle girder frame trailer
Trailer gross weight 312.5t
Tractor 8t (2.55m) 8t (1.35m) 12t (1.35m) 12t
5.60m drawbar - bogie 10 axles x 15.625t - 1.50m crs (17.09m) bogie 10 axles x 15.625t – 1.50m centres
6.30m drawbar - tractor 8t (2.55m) 8t (1.35m) 12t (1.35m) 12t
3.0m width over wheels

Transformer - Allelys 16 axle girder frame
Trailer gross weight 264.8t
Tractor 8t (2.602m) 10t (1.44m) 12t (1.42m) 12t
5.455m drawbar - bogie 8 axles x 16.55t – 1.50m (12.455m) bogie 8 axles x 16.55t – 1.50m
5.94m drawbar - tractor 8t (2.602m) 10t (1.44m) 12t (1.42m) 12t
3.0m width over wheels

Transformer - ALE AL50-16 axle girder frame
Trailer gross weight 275.2t
Tractor 9t (1.70m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 8 axles x 17.2t - 1.5m (16.05m) bogie 8 axles x 17.2t -1.5m
6.970m drawbar - tractor 9t (1.70m) 9t (3.55m) 15t (1.525m) 15t
3.00m width over wheels (2.70m over tractor wheels)

Transformer - ALE AL50-18 axle girder frame
Trailer gross weight 281.2t
Tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 9 axles x 15.6t - 1.5m (15.35m) bogie 9 axles x 15.6t -1.5m
6.970m drawbar - tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
3.00m width over wheels (2.70m over tractor wheels)

Transformer - ALE AL50-16 axle girder frame (widening)
Trailer gross weight 279.6t
Tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 8 axles x 17.47t - 1.65m (14.85m) bogie 8 axles x 17.47t - 1.65m

6.970m drawbar - tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
3.6m (or 4.3m) width over wheels (2.70m over tractor wheels)

Note – ALE vehicles identified above and in the accepted AIP are now operated by Mammoet.

In addition, 60t Cable Drums also require to be transported for the same project under STGO Category 3. The vehicles considered are as below.

60t Cable Drum - 4-Axle Modular Reeling Trailer
Total gross weight 108.3t
Tractor 6.4t (2.602m) 10t (1.44m) 16.5t (1.42m) 16.5t
14.136m space to trailer axles - 4 axles x 14.72t - 1.5m centres

60t Cable Drum - 2-axle bed plus 4-axle Modular Reeling Trailer
Total gross weight 111.6t
Tractor 8.1t (3.2m) 12.7t (1.4m) 12.7t
3.299m space to front bed axles - 2 axles x 14.12t - 1.5m centres
12.449m space to rear bed axles – 4 axles x 14.12t – 1.5m centres

5.2 Grillage Model and Analysis

The assessment has been carried out using a grillage model to represent the bridge superstructure. Longitudinal grillage members were positioned along the lines of the precast beams (T1 & T3 Beams at 0.5m centres) and the parapet edge beams. The precast beam members incorporated the stiffness of the infill concrete and were modelled as rectangular sections (T1 beams – 500mm wide by 480mm deep, T3 beam – 500mm wide by 610mm deep). The parapet edge beams were modelled as a rectangular section (435mm wide by 750mm deep). Transverse members to represent the infill slab and footway slabs sub-divided the span into a suitable number of elements on the skew of 26°. The transverse footway slab was modelled as a rectangular section (858mm wide by 300mm deep). The transverse slab between the precast beams were also modelled as rectangular sections (858mm wide by 480mm deep between T1 beams and 610mm deep between the T3 beams).

The support positions on each longitudinal member were modelled as pinned supports on one side and roller supports on the other. The model was produced using the program ROBOT Structural Analysis Professional.

Vehicle axle loads representing all of the AIL vehicles in the previous section were modelled as moving vehicle loads centred on three individual notional lanes (width

2.83m). The Dynamic Amplification Factor (DAF) and Overload Factors (OF) were applied in accordance with CS 458 to the axle loads and the results of each vehicle compared. The most onerous vehicle effects and positions in each lane were recorded and taken further to the next step, where they were applied in combination with permanent loads and associated HA Assessment live Loading (UDL & KEL) in accordance with CS 454. It was found that the effects from the ALE AL50-16, ALE AL50-18 & ALE AL50-16 (widening) vehicles produced the most onerous effects on the structure. The results of all the other vehicles are considered to fall within these vehicles.

Partial factors on live loadings were used in accordance with CS454 or CS458 as appropriate. Output moments and shears on each of the precast concrete beam, parapet edge beams, transverse footway slab and transverse carriageway slab members were obtained for each combination and compared with the capacities calculated in accordance with CS 455. The resultant moments and shears in the transverse members were converted to 1m wide sections to compare directly with the 1m wide section capacities calculated in accordance with CS 455.

The checker used an independent model, of the same overall dimensions and section properties, applied vehicle loadings as per the AIP and prepared their own member capacity calculations.

6. ASSESSMENT RESULTS

The utilisation ratio between the assessed capacities of the various elements of the structure and the effects from the critical vehicle loadings are given in the table below. A utilisation ratio less than 1.0 indicates that the effects of the critical vehicle can be sustained by the structure or element under consideration.

Effect	Utilisation Ratio					
	Notional Lane 1 (North)		Notional Lane 2 (Middle)		Notional Lane 3 (South)	
	Flexure	Shear	Flexure	Shear	Flexure	Shear
Longitudinal T1 Beams	0.41	0.89	0.41	0.89	0.41	0.9
Longitudinal T3 Beams	0.47	0.89	0.45	0.82	0.52	0.96
Parapet Edge Beams	0.9	0.14	0.88	0.14	0.98	0.15
Transverse Footway Slab	0.24	0.34	0.22	0.36	0.25	0.39
Transverse Carriageway Slab	0.82	0.47	0.68	0.38	0.82	0.48

Note - in all cases the utilisation ratio obtained are less than 1.0

It is therefore evident that the effects (both flexure and shear) of the critical AIL vehicles can be sustained by the structure at any location between the kerbs. A maximum utilisation ratio of 0.98 is obtained in the Parapet Edge Beam on the south of the bridge with the critical vehicle ALE AL50-16 positioned in notional Lane 3 (South). Please note that this load effect includes HA Assessment Live Loading (UDL and KEL) in adjacent notional lanes and full Overload Factors and Dynamic Amplification Factors in accordance with CS 458. However, as advised by the Client, it is anticipated that the axle loads on the proposed AIL vehicles will be well managed, escorted by police and will pass over the bridge at low speed (less than 10mph) and in a central position with all other traffic excluded.

The substructure for the structure has been assessed qualitatively and is considered adequate for the proposed vehicles.

7. CONCLUSIONS

The structure is in good condition as far as was visible at the time of inspection and is capable of carrying the full range of proposed AIL vehicles.

In all load cases normal speed running (greater than 10mph) of the AIL vehicles has been assumed and associated HA assessment live loading is applied in adjacent notional lanes. It is noted however, that due to the alignment of the road and length of the vehicle it may be necessary to exclude all other traffic on the bridge and to travel at a low speed to ensure safe passage. Vehicles should run between the kerbs and not mount the footway. From the site survey and inspection, it would appear that the alignment over the structure will be sufficient and removal of parapets or temporary widening will not be required.

No remedial works in respect of bridge condition are required for the passage of these AIL vehicles.

Appendix A – Photographs

1 – View of bridge from south

2 – View of east approach to bridge

3 – View of west approach to bridge

4 – Top surface of bridge

5 – South side of bridge

6 – North side of bridge

7- Soffit of the deck

8- Soffit of the deck

Appendix B – Approval in Principle

Appendix C – Assessment and Check Certificates

Appendix D – Assessment Calculations

Appendix D
Structural Assessment for A131 Town Bridge at Halstead

WYNNS LTD

TWINSTEAD SUBSTATION AIL ACCESS
BRIDGE ASSESSMENT

A131 TOWN BRIDGE, HALSTEAD
(43/42624)

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February 2023

Doc Ref – 2405/Doc/001

Member of the Association
for Consultancy and Engineering

This document was prepared as follows:-

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Checked By	N Greenwood	[redacted]	February 2023
Approved By	G Brown	[redacted]	February 2023

and revised as follows:

REVISION STATUS INDICATOR

Page No	Date	Revision	Description of Change	Initial

This document has been reviewed for compliance with project requirements in accordance with Wallace Stone LLP Quality Management System.

WYNNS LTD
TWINSTEAD SUBSTATION AIL ACCESS
BRIDGE ASSESSMENT

A131 TOWN BRIDGE
(43/42624)

CONTENTS

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APPENDICES

WYNNS LTD
TWINSTEAD SUBSTATION AIL ACCESS
BRIDGE ASSESSMENTS

A131 TOWN BRIDGE
(43/42624)

1. INTRODUCTION

Wynns has been appointed by National Grid to examine the feasibility of an access route for delivery of a transformer to a new substation location at Twinstead in Essex. As part of this exercise a bridge assessment is required on a bridge on the A131 in Halstead to check the capacity for the possible abnormal loads carrying 178 tonne gross weight transformer, carried by multi axle trailers. The proposed vehicles are considered as Abnormal Indivisible Loads (AIL).

Wynns has appointed Wallace Stone to carry out the assessment of the structure (Structure ref. 43/42624 A131 Town Bridge, Halstead). Details of the structure can be found in Section 2.

An inspection for assessment was carried out on 9th May 2022 by a chartered civil engineer and graduate civil engineer. The weather at the time of inspection was sunny and calm.

2. STRUCTURE DESCRIPTION

The details of the structure are as shown in the Table below.

Ref; name	43/42624 A131 Town Bridge
Grid Ref	TL 81229 30507
Type	Single skew span simply supported concrete bridge. Bridge deck comprises precast prestressed beams with insitu concrete infill slab.
Spans; skew	8.57m clear skew span between bearing centres (7.725m square) with 26° skew
Deck Slab	Under carriageway – 480mm deep comprising 380mm deep T1 beams (20 No.) with 100mm top slab. Under footway – 610 deep comprising 535mm deep T3 beams (2 No. each footway) with 75mm top slab.
Abutments	The deck is supported on an RC U-frame consisting of abutment walls and connecting base slab with the base slab acting as a spread foundation
Carriageway width	Single carriageway approximately 8.5m wide
Footway width	South and north footways average 2.887m and 2.91m respectively
Surfacing depth	90mm surfacing overlaid on 100mm concrete fill
Obstacle crossed	River Colne
Date of construction	Circa 1979

3. PREVIOUS ASSESSMENT SUMMARY

A previous assessment report was provided by Essex County Council. This report is dated February 2010 for a previous abnormal load movement programme. The assessment found the bridge to have sufficient capacity to carry the proposed Abnormal Indivisible Loads specified for the transportation of a 137 Tonnes net weight transformer. There were no positional restrictions for the wheel loads provided they were within the defined carriageway.

4. INTERIM MEASURES SUMMARY

There are no interim measures on the bridge.

5. MONITORING SUMMARY

The previous assessment report (Feb 2010) noted that the cracks in the parapets were being monitored. However, the parapets do not affect the structural capacity of the main deck elements with regards to the passage of the AIL vehicles and were therefore not considered further as part of this assessment.

6. ASSESSMENT INSPECTION SUMMARY

A Principal Inspection Report dated 2021 was provided by Essex County Council and used as a comparison for any changes in condition.

The inspection for assessment was carried out on the 9th May 2022 from the top at road level and from the adjacent land to the north and south of the bridge. Full access below the structure was not achieved due to water level and softness of the riverbed.

There was no change to the condition of the structure observed since the previous Principal Inspection in 2021. The structure is generally in a good condition with no defects noted which could reduce the structure's load capacity to carry the abnormal indivisible loads. A Condition Factor of 1.0 is applicable for all deck elements.

7. ASSESSMENT METHOD & COMMENTARY

7.1 Assessment Information

Drawings were provided by Essex County Council for this structure, as noted in the AIP. These showed the general layout, cross-sections, and details of prestressed main beams, footway beams and reinforced concrete footway slab and parapet beams. Dimensional information given on the drawings was confirmed during the site inspection as far as possible.

The structure has been assessed for the range of vehicles noted in the AIP and summarised in Section 5. Standards and references used were as noted in Annex A to the AIP.

Material properties given on the drawings were:

Element	Material	Strength (MPa)
slab	Prestressed concrete	f_{cu} = 52.5
	Prestressed concrete (transfer)	f_{cu} = 40
	In situ concrete	f_{cu} = 45
	Reinforcement	f_y = 410 (high yield)
	Prestressing tendons	f_{pu} = 1751 (12.7mm ø – 7 wire strand)

AIP for assessment was submitted to Essex County Council on 1st June 2022, and accepted on 7th July 2022. The AIP is found in Appendix B. Assessment and check certificates can be found in Appendix C.

7.2 Assessment Vehicle Details

The vehicles considered for the Transformer movement are as below:-

Transformer - Collett 20 axle girder frame trailer
Trailer gross weight 312.5t
Tractor 8t (2.55m) 8t (1.35m) 12t (1.35m) 12t
5.60m drawbar - bogie 10 axles x 15.625t - 1.50m crs (17.09m) bogie 10 axles x 15.625t – 1.50m centres
6.30m drawbar - tractor 8t (2.55m) 8t (1.35m) 12t (1.35m) 12t
3.0m width over wheels

Transformer - Allelys 16 axle girder frame
Trailer gross weight 264.8t
Tractor 8t (2.602m) 10t (1.44m) 12t (1.42m) 12t
5.455m drawbar - bogie 8 axles x 16.55t – 1.50m (12.455m) bogie 8 axles x 16.55t – 1.50m
5.94m drawbar - tractor 8t (2.602m) 10t (1.44m) 12t (1.42m) 12t
3.0m width over wheels

Transformer - ALE AL50-16 axle girder frame
Trailer gross weight 275.2t
Tractor 9t (1.70m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 8 axles x 17.2t - 1.5m (16.05m) bogie 8 axles x 17.2t -1.5m
6.970m drawbar - tractor 9t (1.70m) 9t (3.55m) 15t (1.525m) 15t
3.00m width over wheels (2.70m over tractor wheels)

Transformer - ALE AL50-18 axle girder frame
Trailer gross weight 281.2t
Tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 9 axles x 15.6t - 1.5m (15.35m) bogie 9 axles x 15.6t -1.5m
6.970m drawbar - tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
3.00m width over wheels (2.70m over tractor wheels)

Transformer - ALE AL50-16 axle girder frame (widening)
Trailer gross weight 279.6t
Tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 8 axles x 17.47t - 1.65m (14.85m) bogie 8 axles x 17.47t - 1.65m
6.970m drawbar - tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
3.6m (or 4.3m) width over wheels (2.70m over tractor wheels)

Note – ALE vehicles identified above and in the accepted AIP are now operated by Mammoet.

In addition, 60t Cable Drums also require to be transported for the same project under STGO Category 3. The vehicles considered are as below.

60t Cable Drum - 4-Axle Modular Reeling Trailer
Total gross weight 108.3t
Tractor 6.4t (2.602m) 10t (1.44m) 16.5t (1.42m) 16.5t
14.136m space to trailer axles - 4 axles x 14.72t - 1.5m centres

60t Cable Drum - 2-axle bed plus 4-axle Modular Reeling Trailer
Total gross weight 111.6t
Tractor 8.1t (3.2m) 12.7t (1.4m) 12.7t
3.299m space to front bed axles - 2 axles x 14.12t - 1.5m centres
12.449m space to rear bed axles – 4 axles x 14.12t – 1.5m centres

7.3 Grillage Model and Analysis

The assessment has been carried out using a grillage model to represent the bridge superstructure. Longitudinal grillage members were positioned along the lines of the precast beams (T1 & T3 Beams at 0.5m centres) and the parapet edge beams. The precast beam members incorporated the stiffness of the infill concrete and were modelled as rectangular sections (T1 beams – 500mm wide by 480mm deep, T3 beam – 500mm wide by 610mm deep). The parapet edge beams were modelled as a rectangular section (435mm wide by 750mm deep). Transverse members to represent the infill slab and footway slabs sub-divided the span into a suitable number of elements on the skew of 26°. The transverse footway slab was modelled as a rectangular section (858mm wide by 300mm deep). The transverse slab between the precast beams were also modelled as rectangular sections (858mm wide by 480mm deep between T1 beams and 610mm deep between the T3 beams).

The support positions on each longitudinal member were modelled as pinned supports on one side and roller supports on the other. The model was produced using the program ROBOT Structural Analysis Professional.

Vehicle axle loads representing all of the AIL vehicles in the previous section were modelled as moving vehicle loads centred on three individual notional lanes (width 2.83m). The Dynamic Amplification Factor (DAF) and Overload Factors (OF) were applied in accordance with CS 458 to the axle loads and the results of each vehicle compared. The most onerous vehicle effects and positions in each lane were recorded and taken further to the next step, where they were applied in combination with permanent loads and associated HA Assessment live Loading (UDL & KEL) in accordance with CS 454. It was found that the effects from the ALE AL50-16, ALE AL50-18 & ALE AL50-16 (widening) vehicles produced the most onerous effects on the structure. The results of all the other vehicles are considered to fall within these vehicles.

Partial factors on live loadings were used in accordance with CS454 or CS458 as appropriate. Output moments and shears on each of the precast concrete beams, parapet edge beams, transverse footway slab and transverse carriageway slab members were obtained for each combination and compared with the capacities calculated in accordance with CS 455. The resultant moments and shears in the transverse members were converted to 1m wide sections to compare directly with the 1m wide section capacities calculated in accordance with CS 455.

The checker used an independent model and section properties, applied the vehicle loadings as per the AIP and prepared their own member capacity calculations. Initially, the checker used a unit strip method as an initial verification followed by a grillage model. The checkers grillage model did not include the parapet edge beams and transverse footway elements as these elements would not receive direct loading from the AIL vehicles travelling on the carriageway.

8. ASSESSMENT RESULTS

A summary of the structural adequacy and reserve factors for individual structural elements are shown in the table below. The full table which includes the assessment load effects from the critical AIL vehicle, associated HA and permanent loads is contained in Appendix A.

Structural Element	Effect	Structural Adequacy Factor	Reserve Factor against a SV Load with associated HA	Reserve Factor against a SV Load without associated HA
		R^*_A/S^*_A	Ψ_{SV}	Ψ^*_{SV}
T1 Beams	ULS Max Moment midspan	2.34	3.27	4.23
	ULS Max Shear at support	1.11	1.16	1.17
T3 Beams	ULS Max Moment midspan	2.29	3.62	4.12
	ULS Max Shear at support	1.02	1.03	1.04
Parapet Edge Beams	ULS Max Moment midspan	2.51	6.11	6.73
	ULS Max Shear at support	8.50	56.00	57.20
	ULS Max Shear at 3d from support	1.86	4.19	4.37
Transverse Footway Slab	ULS Max Moment midspan (sag)	3.81	6.90	7.94
	ULS Max Moment support (hog)	2.33	4.91	5.88
	ULS Max Shear at support	2.52	5.52	6.41
Slab Between T1 Beams	ULS Max Moment midspan (sag)	5.62	5.96	6.18
	ULS Max Moment support (hog)	1.37	1.59	1.87
	ULS Max Shear at support	1.93	2.13	2.25
Slab Between T3 Beams	ULS Max Moment midspan (sag)	17.96	21.07	23.48
	ULS Max Moment support (hog)	2.65	3.40	4.02
	ULS Max Shear at support	4.83	10.26	10.57

All the Structural Adequacy Factors have been calculated as greater than 1.0 for the ULS load effects. The stresses from the SLS loading in both the T1 and T3 prestressed beams are within the class 1 stress limits in accordance with CS 455, therefore the SLS loading is not expected to cause cracking.

T1 Beam – Max compressive stress due to prestress, losses, permanent loads, AIL & associated HA = 14.43N/mm^2 <21 N/mm^2 (Class 1 limit to Table 8.15a of CS455)

T1 Beam – Max tensile stress due to prestress, losses, permanent loads, AIL & associated HA = 0 N/mm^2 ≤ 0 N/mm^2 (Class 1 limit to Table 8.15a of CS455).

T3 Beam – Max compressive stress due to prestress, losses, permanent loads, AIL & associated HA = 11.01N/mm^2 <21 N/mm^2 (Class 1 limit to Table 8.15a of CS455)
T3 Beam – Max tensile stress due to prestress, losses, permanent loads, AIL & associated HA = 0 N/mm^2 ≤ 0 N/mm^2 (Class 1 limit to Table 8.15a of CS455)

It is therefore evident that the effects (both flexure and shear at ULS and stresses in prestressed beams) of the critical AIL vehicles can be sustained by the structure at any location between the kerbs.

The critical structural element is the T3 Prestressed Beams at the edges of the carriageway. A minimum Structural Adequacy Factor for the T3 beam is obtained in the ULS shear effect ($R*_A/S*_A$= 1.02) with the critical vehicle ALE AL50-16 positioned in notional Lane 3 (South). The shear resistance has been calculated from the concrete only and does not taken into account the capacity of the shear links. Please note that this load effect includes HA Assessment Live Loading (UDL and KEL) in adjacent notional lanes and full Overload Factors and Dynamic Amplification Factors in accordance with CS 458. However, as advised by the Client, it is anticipated that the axle loads on the proposed AIL vehicles will be well managed, escorted by police and will pass over the bridge at low speed (less than 10mph) and in a central position with all other traffic excluded. The T3 beams have a reserve factor of 1.03 with the associated HA loading and 1.04 without the associated HA loading.

The substructure for the structure has been assessed qualitatively and is considered adequate for the proposed vehicles.

See table below for a comparison between assessor and checkers results: -

Structural Element	Effect	Assessor Structural Adequacy Factor	Checker Structural Adequacy Factor	Percentage difference
		$R*_A/S*_A$	$R*_A/S*_A$	
T1 Beams	ULS Max Moment midspan	2.34	2.56	+9%
	ULS Max Shear at support	1.11	2.13	+92%
T3 Beams	ULS Max Moment midspan	2.29	3.22	+8%

	ULS Max Shear at support	1.02	2.5	+145%
Slab Between T1 Beams	ULS Max Moment midspan	5.62	3.0	-47%
	ULS Max Shear at support	1.93	2.0	+3.6%

As noted previously the checker’s grillage model did not include the parapet edge beam and the transverse footway slab as they would not be directly loaded by the AIL vehicles on the carriageway. Checker calculations included the shear resistance provided by shear reinforcement and as a result obtained a larger structural adequacy factor for shear than the assessor. The transverse slab capacity between T3 beams was also not calculated by checker. The checker found the load effects in the transverse slab between T3 beams to be less than the load effects in the transverse slab between T1 beams and therefore concluded that the larger slab section would be less onerous than the transverse slab between T1 beams.

9. CONCLUSIONS

The structure is in good condition as far as was visible at the time of inspection and is capable of carrying the full range of proposed AIL vehicles.

In all load cases normal speed running (greater than 10mph) of the AIL vehicles has been assumed and associated HA assessment live loading is applied in adjacent notional lanes. It is noted however, that due to the alignment of the road and length of the vehicle it may be necessary to exclude all other traffic on the bridge and to travel at a low speed to ensure safe passage. Vehicles should run between the kerbs and not mount the footway. From the site survey and inspection, it would appear that the alignment over the structure will be sufficient and removal of parapets or temporary widening will not be required.

No remedial works in respect of bridge condition are required for the passage of these AIL vehicles.

Appendix A – Summary of Results

Element	Effect	Factored AIL Load Effect		Factored Dead & SDL Loads Effect		Factored associated HA Load Effect		Total Factored Assessment Load Effect		Assessment Resistance		Structural Adequacy Factor	Reserve Factor against a SV Load <u>with</u> associated HA	Reserve Factor against a SV Load <u>without</u> associated HA
		S^*		S^*_D		S^*_{HA}		S^*_A		R^*_A		R^*_A/S^*_A	Ψ_{SV}	Ψ^*_{SV}
T1 Beams	ULS Max Moment midspan	84.10	kNm	82.77	kNm	35.29	kNm	202.16	kNm	473.71	kNm	2.34	3.27	4.23
	ULS Max Shear at support	86.09	kN	44.88	kN	6.29	kN	137.26	kN	151.82	kN	1.11	1.16	1.17
T3 Beams	ULS Max Moment midspan	138.12	kNm	170.75	kNm	26.04	kNm	334.91	kNm	765.34	kNm	2.29	3.62	4.12
	ULS Max Shear at support	87.20	kN	78.91	kN	17.75	kN	183.86	kN	187.35	kN	1.02	1.03	1.04
Parapet Edge Beams	ULS Max Moment midspan	112.80	kNm	301.11	kNm	13.66	kNm	427.56	kNm	1073.4	kNm	2.51	6.11	6.73
	ULS Max Shear at support	26.23	kN	169.84	kN	0.57	kN	196.64	kN	1670.9 9	kN	8.50	56.00	57.20
	ULS Max Shear at 3d from support	28.48	kN	81.18	kN	1.62	kN	111.28	kN	207.32	kN	1.86	4.19	4.37
Transverse Footway Slab	ULS Max Moment midspan (sag)	10.75	kNm/m	13.92	kNm/m	1.90	kNm/m	26.56	kNm/m	101.13	kNm/m	3.81	6.90	7.94
	ULS Max Moment support (hog)	6.04	kNm/m	14.55	kNm/m	1.50	kNm/m	22.08	kNm/m	51.52	kNm/m	2.33	4.91	5.88
	ULS Max Shear at support	12.55	kN/m	29.49	kN/m	2.47	kN/m	44.51	kN/m	112.37	kN/m	2.52	5.52	6.41

Element	Effect	Factored AIL Load Effect		Factored Dead & SDL Loads Effect		Factored associated HA Load Effect		Total Factored Assessment Load Effect		Assessment Resistance		Structural Adequacy Factor	Reserve Factor against a SV Load **with** associated HA	Reserve Factor against a SV Load **without** associated HA
		S^*		S^*_D		S^*_{HA}		S^*_A		R^*_A		R^*_A/S^*_A	Ψ_{SV}	Ψ^*_{SV}
Slab Between T1 Beams	ULS Max Moment midspan (sag)	34.33	kNm/m	2.59	kNm/m	1.53	kNm/m	38.45	kNm/m	216.25	kNm/m	5.62	5.96	6.18
	ULS Max Moment support (hog)	14.64	kNm/m	12.65	kNm/m	7.18	kNm/m	34.47	kNm/m	47.25	kNm/m	1.37	1.59	1.87
	ULS Max Shear at support	78.23	kN/m	18.31	kN/m	8.67	kN/m	105.20	kN/m	202.96	kN/m	1.93	2.13	2.25
Slab Between T3 Beams	ULS Max Moment midspan (sag)	13.04	kNm/m	2.68	kNm/m	1.57	kNm/m	17.29	kNm/m	310.5	kNm/m	17.96	21.07	23.48
	ULS Max Moment support (hog)	18.59	kNm/m	10.68	kNm/m	4.78	kNm/m	34.05	kNm/m	90.24	kNm/m	2.65	3.40	4.02
	ULS Max Shear at support	21.00	kN/m	30.77	kN/m	0.72	kN/m	52.48	kN/m	253.5	kN/m	4.83	10.26	10.57

Appendix B – Photographs

1 – View of bridge from south

2 – View of east approach to bridge

3 – View of west approach to bridge

4 – Top surface of bridge

5 – South side of bridge

6 – North side of bridge

7- Soffit of the deck

8- Soffit of the deck

Appendix C – Approval in Principle

Approval in Principle application by:

Wallace Stone
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G40 1DA

Name of Project	**Twinstead Substation Access**
Name of Bridge or Structure	**A131 Town Bridge**
Structure Ref No	**ECC Bridge No 43/42624**

A new Super Grid Transformer (SGT) requires to be transported as part of the Bramford to Twinstead Reinforcement project which includes the construction of a new Substation at Twinstead by National Grid. An assessment for proposed AIL vehicles is required to confirm the suitability of the route identified for SGT delivery from Tilbury Docks to the south via the A131. In addition, 60t Cable Drums also require to be transported for the same project under STGO category 3. The transformer and cable drum deliveries are estimated for November 2023.

1. HIGHWAY DETAILS

1.1	Type of highway	Single Carriageway A131 (Bridge Street, Halstead)
1.2	Permitted traffic speed	48.3 kph (30 mph)
1.3	Existing restrictions	none

2. SITE DETAILS

2.1	Obstacles crossed	River Colne

3. STRUCTURE DETAILS

3.1	Description of structure	Town Bridge carries a single carriageway section of the A131 (Bridge Street) over the River Colne in Halstead, at grid reference TL 581224 230500. The main part of the deck under the carriageway comprises 20No. 380mm deep T1 Beams and 4No. 535mm deep T3 beams pre-stressed inverted T beams (2No. each side) with insitu concrete infill, simply supported on reinforced concrete abutment walls. There are also two separate RC edge beams supporting the North and South parapets, and thin connecting duct bay slabs under both footways. The line of the abutments is skewed to the perpendicular to carriageway at approximately 26°. The kerb lines across the bridge are neither parallel to each other nor straight and the footway

		widths across the bridge consequently vary. The square width of the carriageway on the bridge is approximately 8.5m while the width of the south and north footways average 2.887m and 2.91m respectively. The clear square width between inside faces of the brick and concrete parapets is 14.3m.
3.2	Structural type	Single span, simply supported concrete bridge.
3.3	Foundation type	The deck is founded on an RC U-frame consisting of abutment walls and base slab, with the base slab acting as a spread foundation.
3.4	Span arrangements	Simply supported deck with a clear skew span of 8.57m between centrelines of bearings for the prestressed beams (7.725m square)
3.5	Articulation arrangements	Simply supported
3.6	Types of road restraint systems	The parapets comprise decorative brick-clad concrete pillars with infill panels formed with concrete pilasters.
3.7	Proposed arrangements for Inspection for Assessment	
	3.7.1 Traffic management	Not required – foot access topside via public footways.
	3.7.2 Access	Foot access to the adjacent riverbanks via street called The Causeway to the Southwest and via adjacent property to the Southeast.
	3.7.3 Intrusive or further investigations proposed	None
3.8	Environment and Sustainability	Not applicable
3.9	Durability - materials strengths assumed and basis of assumptions	prestressed concrete f_{cu} = 52.5 MPa prestressed concrete (transfer) f_{cu} = 40 MPa insitu concrete f_{cu} = 45 MPa pre-tensioning strand f_{pu} = 1860 MPa (12.7mm ø – 7 wire steel strand) Material information above obtained from record drawings. reinforcement f_y = 410 MPa high yield, 250 MPa mild steel Reinforcement information obtained from British Standard identified on record drawings.
3.10	Risks and hazards considered	work in or near water
3.11	Year of construction	1979

3.12	Reason for assessment	To confirm capacity for passage of abnormal loads in connection with transformer delivery
3.13	Part of structure to be assessed	Superstructure; also substructure qualitatively to CS459

4. DESIGN CRITERIA

4.1	Actions	
4.1.1	Permanent actions	Dead load of structure
4.1.2	Snow, wind and thermal actions	Not critical to assessment
4.1.3	Actions relating to normal traffic under AW regulations and C&U regulations	The proposed vehicles in 4.1.4 and 4.1.6 below will be escorted by the police. All other traffic will need to be excluded while the load crosses the bridge in terms of physical road space and negotiability requirements irrespective of structural requirements. The exact escort requirements will be agreed by the appointed haulage contractor with the police nearer the time of movement.
4.1.4	Actions relating to General Order traffic under STGO regulations	See Annex C for real vehicles proposed to transport 60t Cable Drums (using principles of CS458). DAF = 1.0 for low speed running, as CS458 B3.1 if required. Due to geometry of the road, vehicle considered at any cross-section. The load will be Special Traffic General Order Type (Category 3).
4.1.5	Footway or footbridge variable actions	to CS454
4.1.6	Actions relating to Special Order Traffic, provision for exceptional abnormal indivisible loads including location of vehicle track on deck cross-section	See Annex D for real vehicles proposed to transport the transformer (using principles of CS458). DAF = 1.0 for low speed running, as CS458 B3.1 if required. Due to geometry of the road, vehicle considered at any cross-section. The load will be Special Order Type.
4.1.7	Accidental actions	Not applicable
4.1.8	Actions during construction	Not applicable
4.1.9	Any special loading 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	None
4.3	Minimum headroom provided	Not applicable

4.4	Authorities consulted and any special conditions required	Not applicable
4.5	Standards and documents listed in the Technical Approval Schedule	See Annex A
4.6	Proposed departures relating to departures from standards given in 4.5	In the first instance the assessment will assume Overload Factor (OF) = 1.2 on critical axle and OF =1.1 on other axles. However, if necessary, we propose to discuss with TA the possibility of reducing the OF to 1.1 for all axles (justified on the basis that on a multi axle bogie the additional 10% load on the critical axle represents an increase in overall load of about 1%. Also axle loads are well managed).
4.7	Proposed departures relating to methods for dealing with aspects not covered by Standards in 4.5	Not applicable

5. STRUCTURAL ANALYSIS

5.1	Methods of analysis proposed for superstructure, substructure and foundations	Grillage / finite element analysis of superstructure. Substructure and foundations – qualitative assessment in accordance with CS459
5.2	Description and diagram of idealised structure to be used for analysis	Grillage model – see Annex B, run on Robot Structural Analysis Professional
5.3	Assumptions intended for calculation of structural element stiffness	Gross concrete sections
5.4	Proposed range of soil parameters to be used in the assessment of earth retaining elements	Not applicable

6. GEOTECHNICAL CONDITIONS

6.1	Acceptance of recommendations of the Geotechnical Design Report to be used in the assessment and reasons for any proposed changes	Not applicable
6.2	Summary of design for highway structure in Geotechnical Design Report	Not available
6.3	Differential settlement to be allowed for in the assessment of the structure	Not applicable to assessment

7. CHECKING

7.1	Proposed Category	2
7.2	If Category 3, name of proposed independent Checker	Not applicable

8. DRAWINGS AND DOCUMENTS

8.1	List of drawings (including numbers) and documents accompanying the submission	(none)
8.2	List of construction and record drawings (including numbers) to be used in the assessment	B43/2/I – General Arrangement B43/2/3 – Abutment Details B43/2/7 – Deck and Parapet Beam Reinforcement B43/2/8 – Prestressed Beam Details
8.3	List of pile driving or other construction records	None
8.4	List of previous inspection and assessment reports	Assessment Report carried out by Mouchel (for Wynns Transport) dated February 2010 Principal Inspection Report dated 11th August 2021

9. THE ABOVE IS SUBMITTED FOR ACCEPTANCE

Signed	[redacted]
Name	Richard Donnet Assessment Team Leader
Engineering Qualifications	MEng(Hons), CEng, MICE
Name of Organisation	Wallace Stone LLP
Date	*28th June 2022*

Signed	[redacted]
Name	Nigel Greenwood Check Team Leader
Engineering Qualifications	BSc(Hons), CEng, MICE, MIStructE
Name of Organisation	Wallace Stone LLP
Date	*28th June 2022*

9.1. THE ABOVE IS ~~REJECTED~~/ACCEPTED AND RECOMMENDED FOR ACCEPTANCE

Signed	[redacted] Digitally signed by Richard Hollis Date: 2022.07.01 15:53:38 +01'00'
Name	Richard Hollis
Engineering Qualifications	BSc CEng MICE
Name of Organisation	Ringway Jacobs
Date	01/07/2022

9.2. THE ABOVE IS ~~REJECTED/~~AGREED SUBJECT TO THE AMENDMENTS AND CONDITIONS SHOWN BELOW

Signed Clive Woodruff Digitally signed by Clive Woodruff Date: 2022.10.10 16:45:04 +01'00'

Name Clive Woodruff

TAA Essex County Council

Date

ANNEX A

Schedule of Design Documents Relating to Assessment of Highway Bridges and Structures

Miscellaneous

Traffic Management Act 2004

Construction (Design and Management) Regulations 2015

The Design Manual for Roads and Bridges (DMRB)

Bridges and Structures, Standards (BD Series)

BD37/88	Loads for highway bridges

Bridges and Structures, Standards (CG/CS Series)

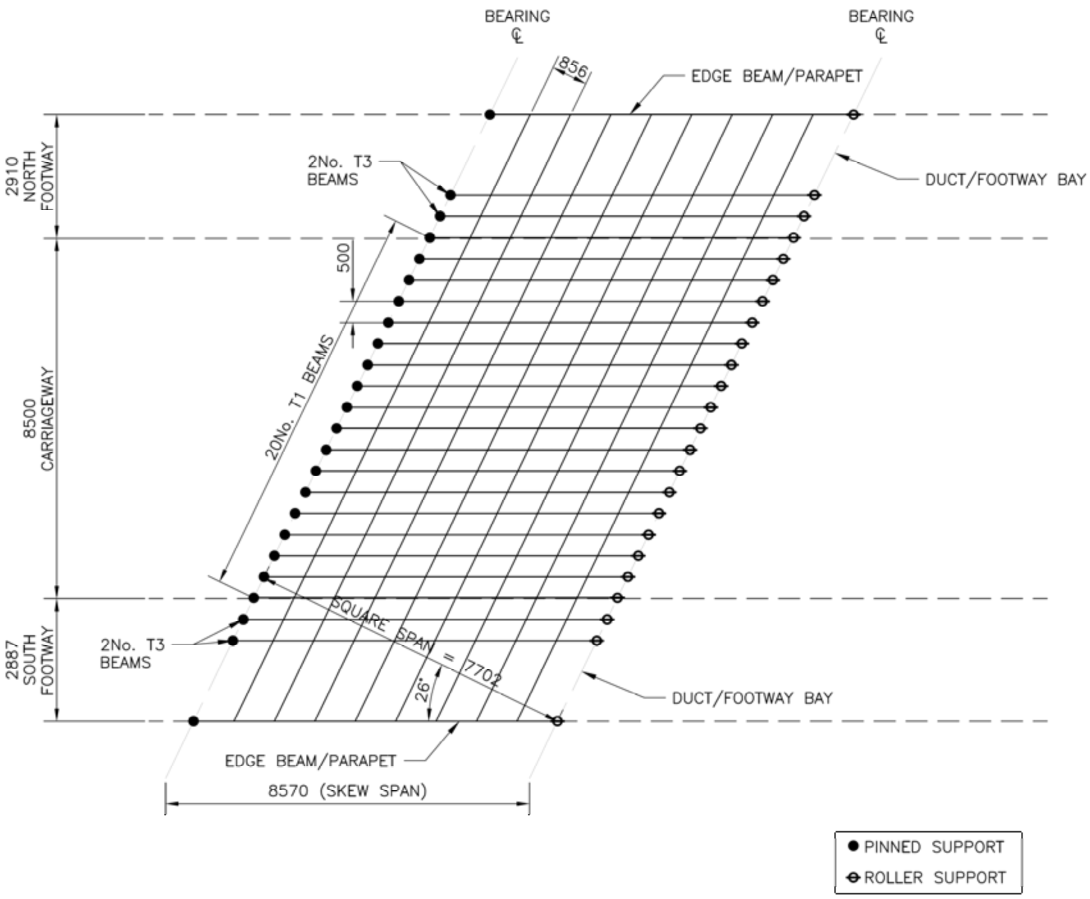
CG 300	Technical approval of highway structures
CS 450	Inspection of highway structures
CS 451	Structural review and assessment of highway structures
~~CS 453~~	~~The assessment of highway bridge supports~~
CS 454	Assessment of highway bridges and structures
CS 455	The assessment of concrete highway bridges and structures
~~CS 456~~	~~The assessment of steel highway bridges and structures~~
~~CS 457~~	~~The assessment of composite highway bridges and structures~~
CS 458	The assessment of highway bridges and structures for the effects of special type general order (STGO) and special order (SO) vehicles
CS 459	The assessment of bridge substructures, retaining structures and buried structures
~~CS 460~~	~~Management of corrugated steel buried structures~~
~~CS 470~~	~~Management of substandard highway structures~~

British Standards

BS 3617	Specification for 7 wire steel strand
BS 5896 : 1980	High tensile steel wire and strand for the prestressing of concrete

ANNEX B

Grillage Layout Sketch



ANNEX C

Details of Proposed Transport Vehicles – STGO (to Cl 4.1.4)

60t Cable Drum - 4-Axle Modular Reeling Trailer
Total gross weight 108.3t
Tractor 6.4t (2.602m) 10t (1.44m) 16.5t (1.42m) 16.5t
14.136m space to trailer axles - 4 axles x 14.72t - 1.5m centres

60t Cable Drum - 2-axle bed plus 4-axle Modular Reeling Trailer
Total gross weight 111.6t
Tractor 8.1t (3.2m) 12.7t (1.4m) 12.7t
3.299m space to front bed axles - 2 axles x 14.12t - 1.5m centres
12.449m space to rear bed axles – 4 axles x 14.12t – 1.5m centres

ANNEX D

Details of Proposed Transport Vehicles – Special Order (to Cl 4.1.6)

Transformer - Collett 20 axle girder frame trailer
Trailer gross weight 312.5t
Tractor 8t (2.55m) 8t (1.35m) 12t (1.35m) 12t
5.60m drawbar - bogie 10 axles x 15.625t - 1.50m crs (17.09m) bogie 10 axles x 15.625t – 1.50m crs
6.30m drawbar - tractor 8t (2.55m) 8t (1.35m) 12t (1.35m) 12t
3.0m width over wheels

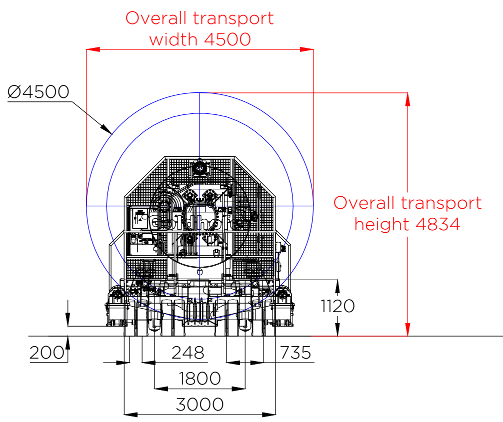
Transformer - Allelys 16 axle girder frame
Trailer gross weight 264.8t
Tractor 8t (2.602m) 10t (1.44m) 12t (1.42m) 12t
5.455m drawbar - bogie 8 axles x 16.55t – 1.50m (12.455m) bogie 8 axles x 16.55t – 1.50m
5.94m drawbar - tractor 8t (2.602m) 10t (1.44m) 12t (1.42m) 12t
3.0m width over wheels

Transformer - ALE AL50-16 axle girder frame
Trailer gross weight 275.2t
Tractor 9t (1.70m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 8 axles x 17.2t - 1.5m (16.05m) bogie 8 axles x 17.2t -1.5m
6.970m drawbar - tractor 9t (1.70m) 9t (3.55m) 15t (1.525m) 15t
3.00m width over wheels (2.70m over tractor wheels)

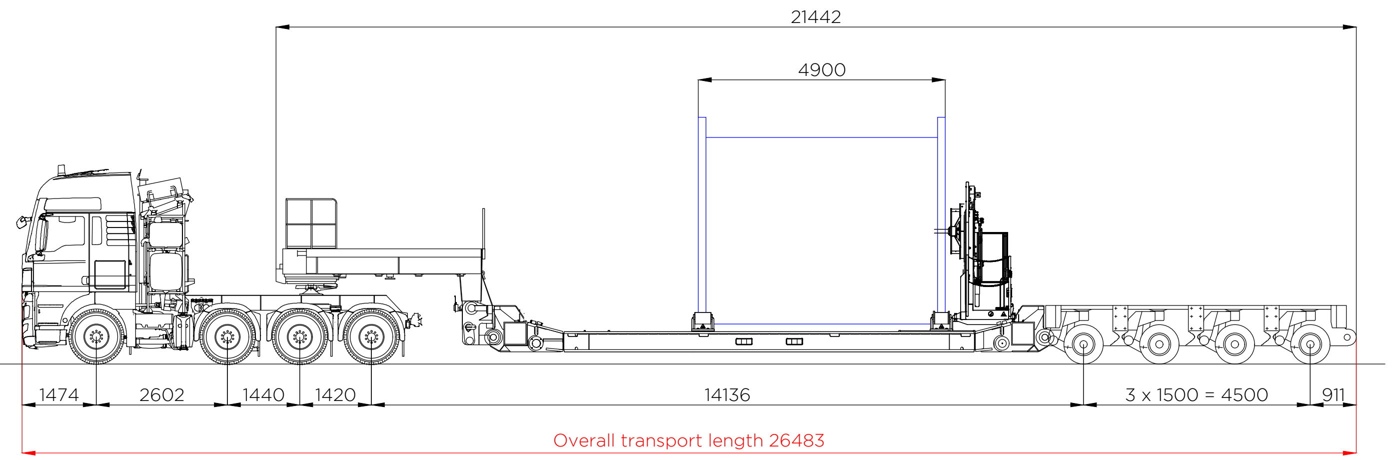
Transformer - ALE AL50-18 axle girder frame
Trailer gross weight 281.2t
Tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 9 axles x 15.6t - 1.5m (15.35m) bogie 9 axles x 15.6t -1.5m
6.970m drawbar - tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
3.00m width over wheels (2.70m over tractor wheels)

Transformer - ALE AL50-16 axle girder frame (widening)
Trailer gross weight 279.6t
Tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 8 axles x 17.47t - 1.65m (14.85m) bogie 8 axles x 17.47t -1.65m
6.970m drawbar - tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
3.6m (or 4.3m) width over wheels (2.70m over tractor wheels)

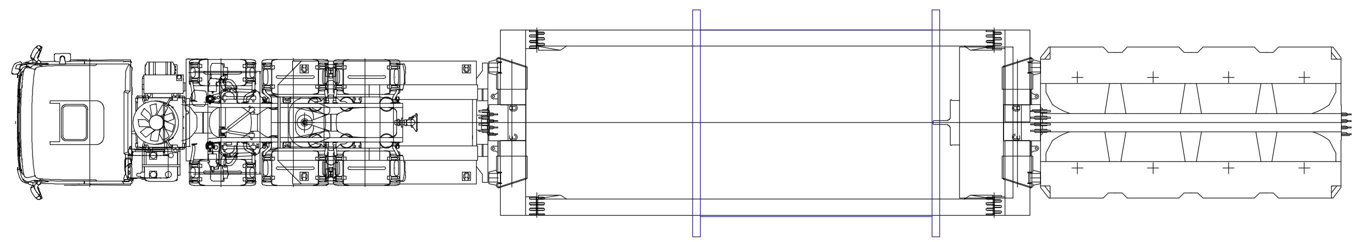
(see vehicle drawings on pages following)



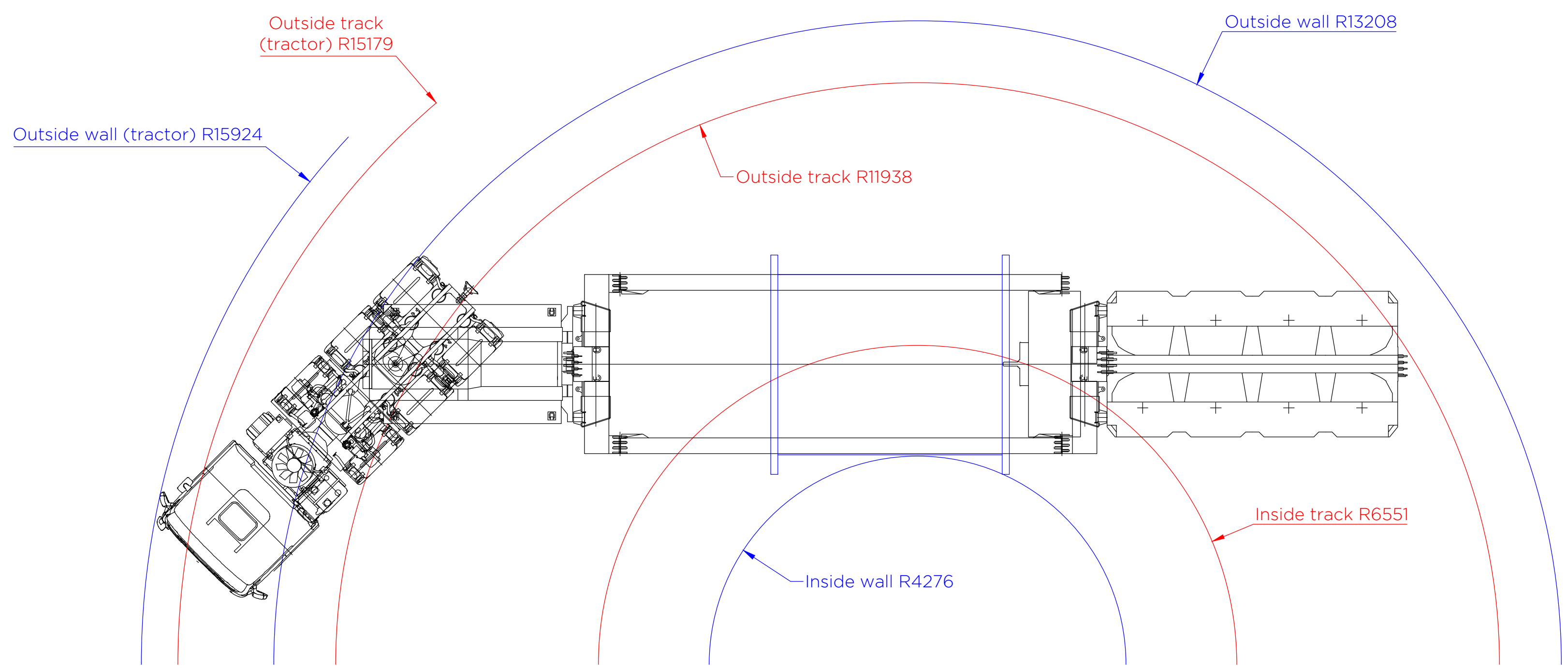
Profile view



Elevation view - 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum



Plan view - 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum



Minimum turning radii information
4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum

Load table

4 axle modular reeling trailer	
Self weight of cable drum	60.0 te
Self weight of trailer	33.3 te
Self weight of tractor	15.0 te
Total combined weight	108.3 te
Load per axle line (trailer)	14.72 te
Load per axle	7.36 te
Load per wheel (4 per axle)	1.84 te
Overall ground bearing pressure	3.27 te/m²

Tractor (15 te)	
Front axle	6.4 te
Second steer	10.0 te
Rear axle	16.5 te
Rear axle	16.5 te

Notes:

[1] The figures shown above are representative of the transport configuration portrayed. However as tractor and trailer arrangements vary then the loads and dimensions indicated should be treated as probable values.

[2] Actual dimensions, including axle spacing and mean running height, may vary slightly depending on manufacturer of trailer deployed.

[3] All linear measures in millimetres unless stated otherwise.

Rev.	Date	Amendments
1		
0	24.05.21	Issued for comment

Revisions

Prepared by:

Shaftesbury House, 2 High Street,
Eccleshall, Stafford, ST21 6BZ
Tel: (01785) 850411

Independent Transportation Engineers

Client:

National Grid
Hams Lane
Coleshill
West Midlands
B46 1AW

Project:

Bramford to Twinstead

Title:

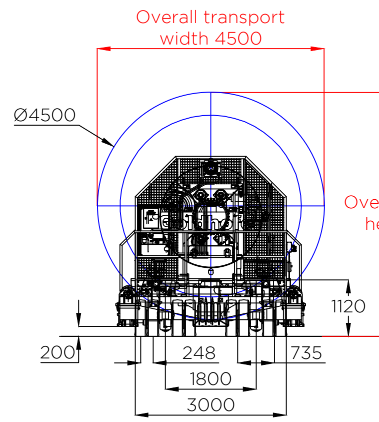
Indicative transport configuration
Indicative 60.0 te cable drum carried on
4 axle modular reeling trailer
showing minimum turning radii

Drawing status:

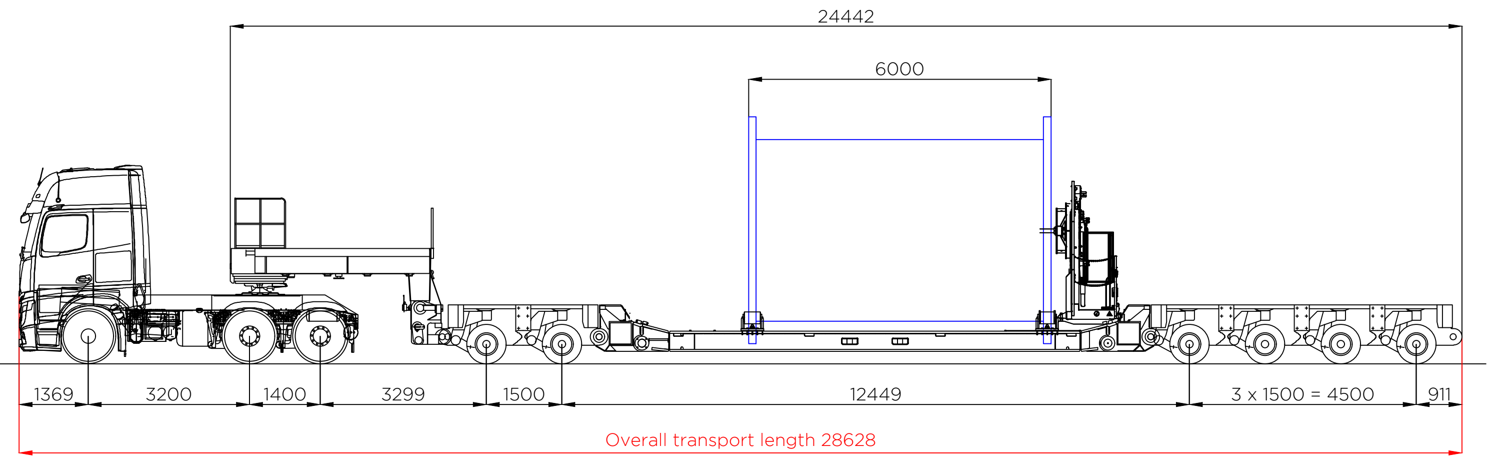
Final report

Scale (A3):	Drawn By:	Checked By:
1:150	SJW	ARP
Dwg. no:	**Sheet:**	**Rev:**
21-1030.TC01	1 of 1	0

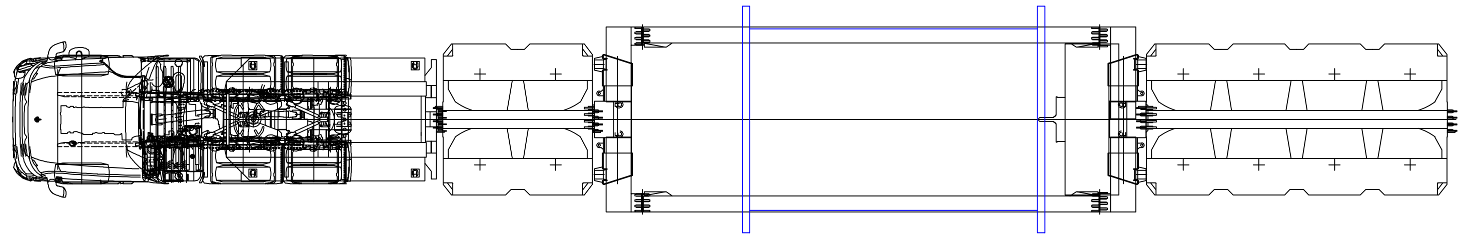
P:\Clients\Existing Clients\National Grid Company\Proposed New sites Investigations\21-1030 Bramford to Twinstead\Cable drums 2021\21-1030.TC01 Bramford to Twinstead cable drum 4 axle spooling trailer transport configuration R0.dwg



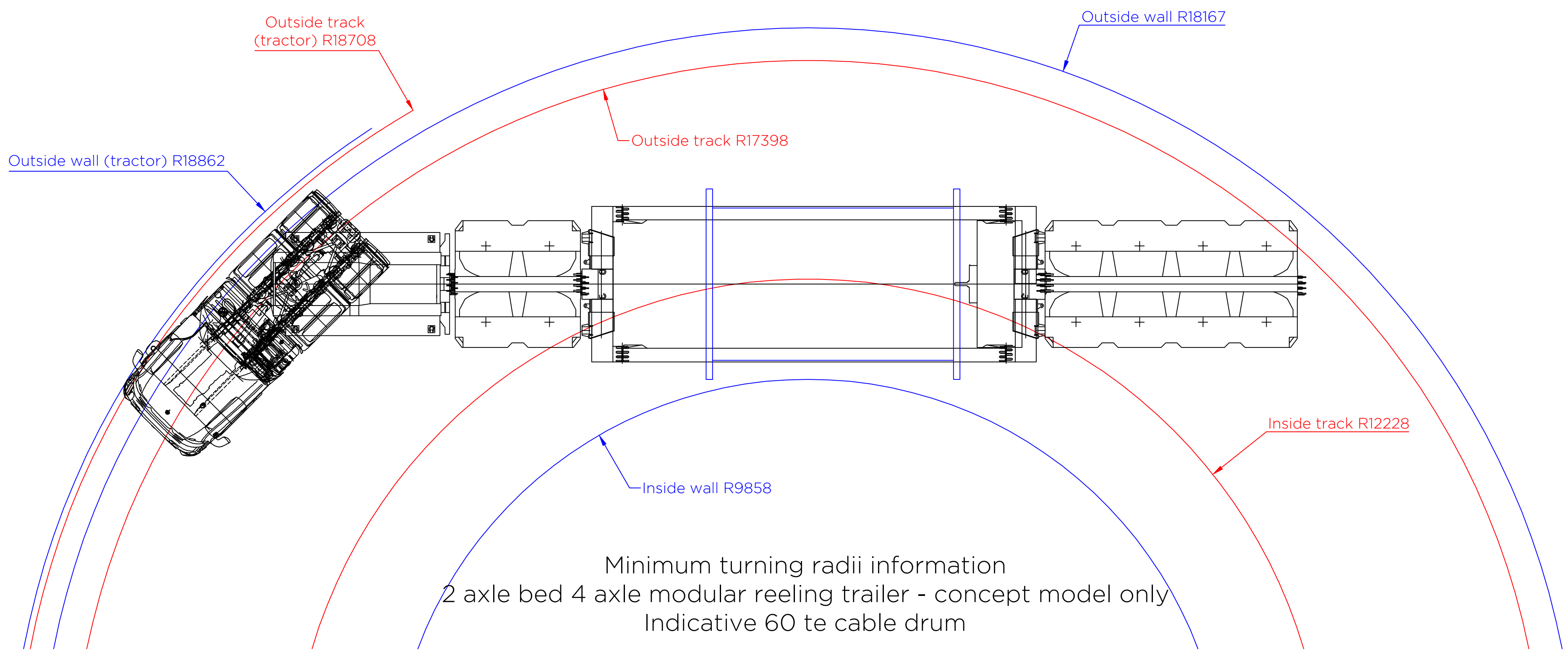
Profile view



Elevation view - 2 axle bed 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum



Plan view - 2 axle bed 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum



Minimum turning radii information
2 axle bed 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum

Load table

4 axle modular reeling trailer

Self weight of cable drum	60.0 te
Self weight of trailer	39.6 te
Self weight of tractor	12.0 te
Total combined weight	111.6 te
Max. load per axle line (trailer)	14.12 te
Load per axle	7.06 te
Load per wheel (4 per axle)	1.77 te
Max. overall ground bearing pressure (trailer)	4.77 te/m²

Tractor (12 te)

Front steer	8.1 te
Rear axle	12.7 te
Rear axle	12.7 te

Notes:

[1] The figures shown above are representative of the transport configuration portrayed. However, as tractor and trailer arrangements vary then the loads and dimensions indicated should be treated as probable values.

[2] Actual dimensions, including axle spacing and mean running height, may vary slightly depending on manufacturer of trailer deployed.

[3] All linear measures in millimetres unless stated otherwise.

[4] Minimum turning radii based upon maximum steering angle of 45 degrees. Some trailers operate to a maximum steering angle of 60 degrees, which will improve negotiability.

Rev.	Date	Amendments
1		
0	17.06.22	Issued for comment

Revisions

Prepared by:

WYNNS Independent Transportation Engineers
Shaftesbury House, 2 High Street, Eccleshall, Stafford, ST21 6BZ
Tel: (01785) 850411
Independent Transportation Engineers

Client:

nationalgrid
National Grid
Hams Lane
Coleshill
West Midlands
B46 1AW

Project:
Bramford to Twinstead

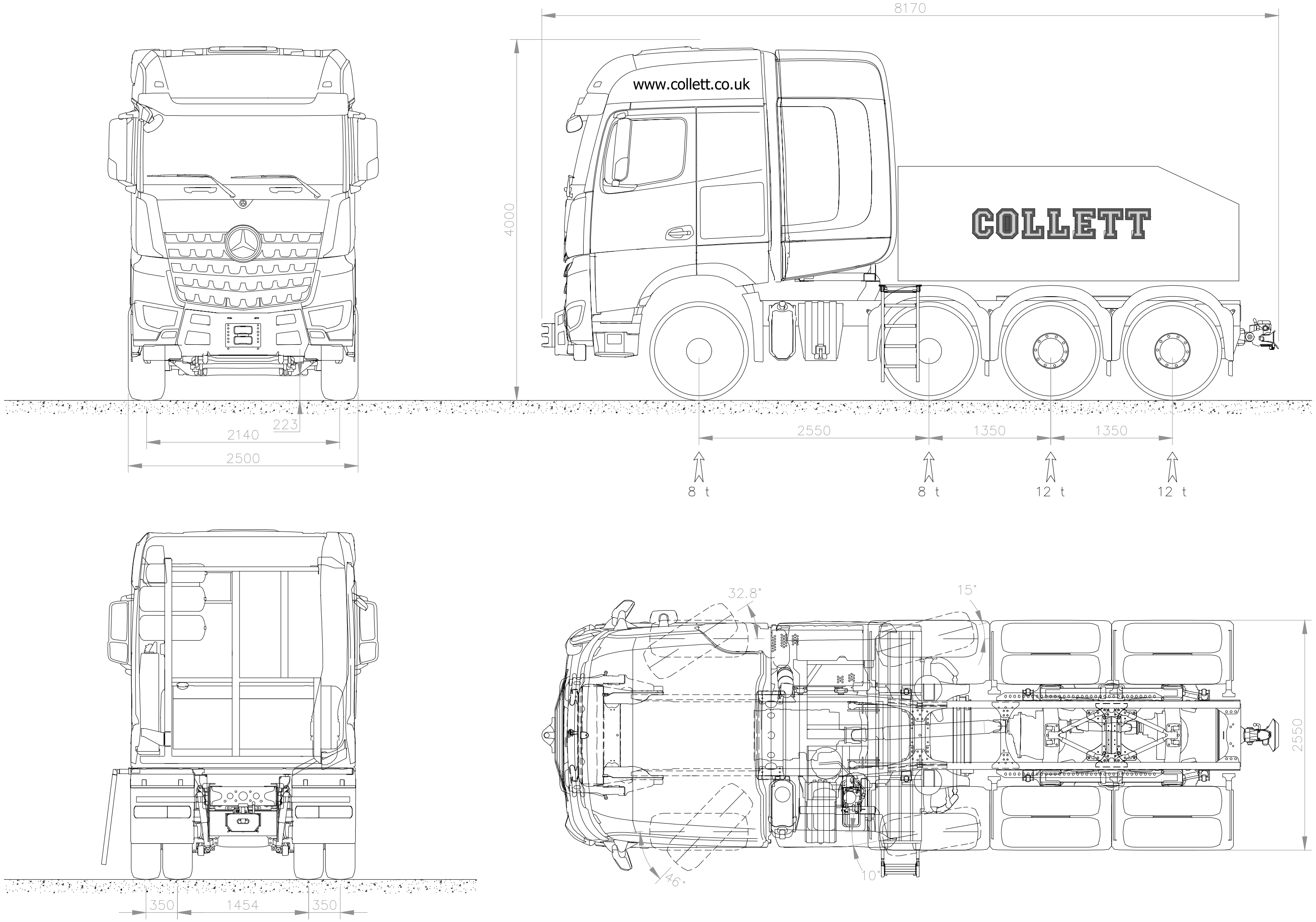
Title:
Indicative transport configuration
Indicative 60.0 te cable drum carried on
2 axle bed 4 axle modular reeling trailer
showing minimum turning radii

Drawing status:
Final report

Scale (A3):	Drawn By:	Checked By:
1:150	SJW	---
Dwg. no:	**Sheet:**	**Rev:**
21-1030.TC07	1 of 1	0

P:\Clients\Existing Clients\National Grid Company\Proposed New sites Investigations\21-1030 Bramford to Twinstead\Transport configuration\21-1030.TC07 Bramford to Twinstead 60 te cable drum 2 axle bed 4 axle spooling trailer R0.dwg

Tyre Sizes	
Axle Line	Tyres
1.	385/65 R22.5
2.	385/65 R22.5
3.	315/80 R22.5
4.	315/80 R22.5



For Information

1. THIS DRAWING IS RELEASED FOR INFORMATION ONLY.
2. ALL DIMENSIONS ARE IN MILLIMETRES (mm) UNLESS OTHERWISE STATED.
3. ALL WEIGHTS ARE IN METRIC TONNES (t) UNLESS OTHERWISE STATED.
4. ALL EQUIPMENT IS SUPPLIED IN ACCORDANCE WITH COLLETT & SONS LIMITED TERMS AND CONDITIONS, AND THE RELEVANT R.H.A. 2009 TERMS AND CONDITIONS.
5. WITHOUT AUTHORISED SIGNATURES THIS DOCUMENT IS UNCONTROLLED, NOT BINDING AND FOR INDICATIVE PURPOSES ONLY.

Rev:	Drawn by:	Date:	Checked by:	Date:
00		2018		

Description:

Client:

Project:

Title:

Mercedes 8x4 Ballast Truck

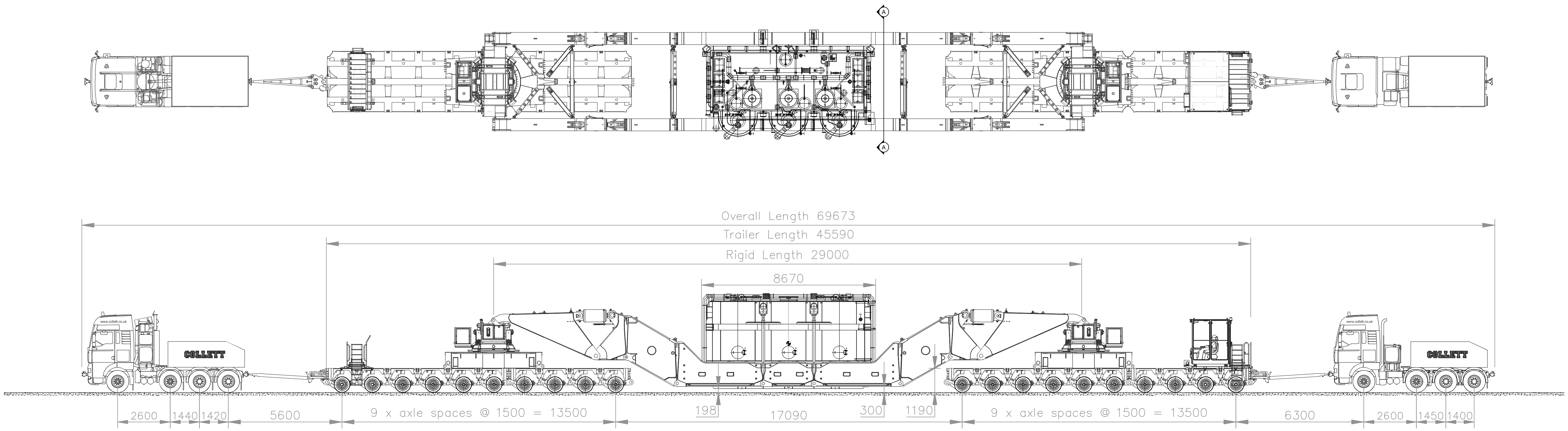
COLLETT
EXPERTS IN MOTION

COLLETT & SONS LTD
Mistral Point
A.W Nielsen Road
Goole
East Yorkshire
DN14 6UE

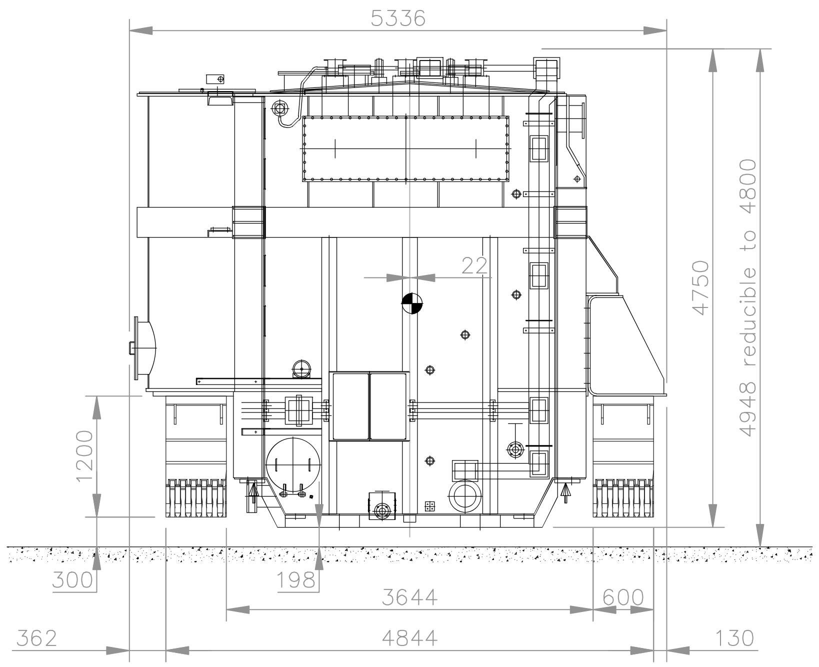
Tel: 08456 255233
Fax: 08456 255277
Web: www.collett.co.uk

Paper Size:	Scale:	Project No:	Drawing No:	Sheet No:
A3	1:50			1 of 1

PLAN & SIDE ELEVATION. SCALE 1:200



SECTION A-A. SCALE 1:75



Preliminary

1.	THIS DRAWING IS PRELIMINARY AND RELEASED FOR INFORMATION ONLY.
2.	ALL DIMENSIONS ARE IN MILLIMETRES (mm) UNLESS OTHERWISE STATED.
3.	ALL WEIGHTS ARE IN METRIC TONNES (t) UNLESS OTHERWISE STATED.
4.	THE CLIENT IS RESPONSIBLE FOR THE PREPARATION OF THE TRANSPORT AREAS TO ENSURE THAT IT IS CAPABLE OF ACCOMMODATING THE LOADS GENERATED BY THE TRAILERS DURING ALL TRANSPORT / LOADING AND UNLOADING OPERATIONS. GROUND TO BE SUITABLY COMPACTED AND LEVELLED FOR A SAFE AND CONVENIENT TRANSPORT OPERATION.
5.	THE CLIENT IS RESPONSIBLE FOR THE STRUCTURAL INTEGRITY OF THE LOAD TRANSPORTED.
6.	THE CLIENT IS TO IDENTIFY AND CONFIRM THE SUITABILITY OF THE SUPPORT POINTS ON THE LOAD TO BE UTILISED DURING TRANSPORT.
7.	SECURE CARGO ONTO THE TRAILER USING LASHING MATERIAL TO PREVENT SLIDING AND/OR TIPPING OF THE LOAD. ALL STRAPS AND CHAINS TO BE TIGHTENED WITH RATCHET BINDERS. ANTI SLIP RUBBER MATTING TO BE USED BETWEEN THE TRAILER AND THE BASE OF THE LOAD INCLUDING ALL STEEL CONTACT AREAS TO PROMOTE FRICTION.
8.	ALL EQUIPMENT IS SUPPLIED IN ACCORDANCE WITH COLLETT & SONS LIMITED TERMS AND CONDITIONS, AND THE RELEVANT R.H.A. 2009 TERMS AND CONDITIONS.
9.	WITHOUT AUTHORISED SIGNATURES THIS DOCUMENT IS UNCONTROLLED, NOT BINDING AND FOR INDICATIVE PURPOSES ONLY.

Weights Table

Type	Description	Weight
Type of Trailer	10 Axle Girder Set 10 Axle	134.500 t
Type of Load	Transformer	178.000 t
	Total loaded weight excluding tractor units	312.500 t
	Load per axle line on trailer	15.625 t
	Load per axle	7.813 t
	Load per wheel	1.953 t

Abnormal Load Classification: **Special Order (BE16)**

Rev:	Drawn by:	Date:	Checked by:	Date:
01	JW	13/12/2018	EC	13/12/2018

Description: Weight amended.

Client: **COLLETT HEAVY LIFT**

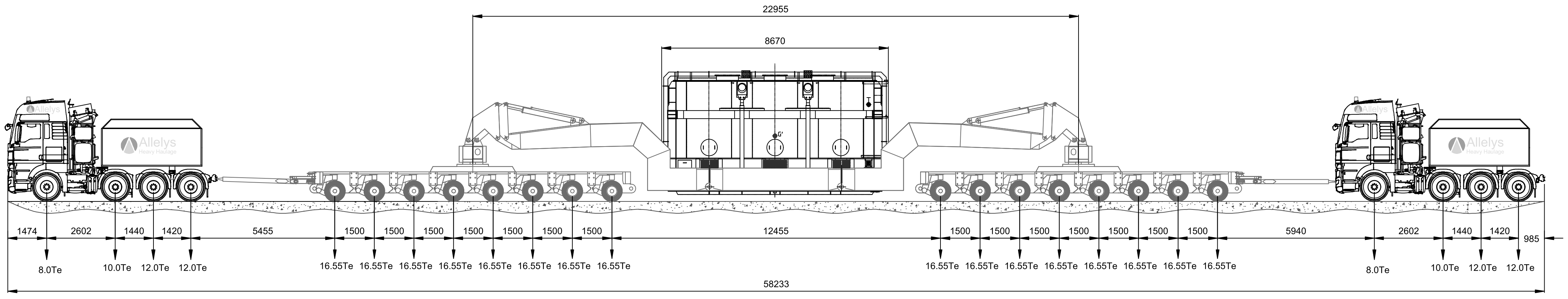
Project: **Taunton Substation**

Title: **Transport Arrangement**

COLLETT EXPERTS IN MOTION

COLLETT & SONS LTD
Mistral Point
A.W Nielsen Road
Goole
East Yorkshire
DN14 6UE
Tel: 08456 255233
Fax: 08456 255277
Web: www.collett.co.uk

Paper Size:	Scale:	Project No:	Drawing No:	Sheet No:
A3	As Noted	322727	COL-D-322727-1-1	1 of 1



SIDE ELEVATION
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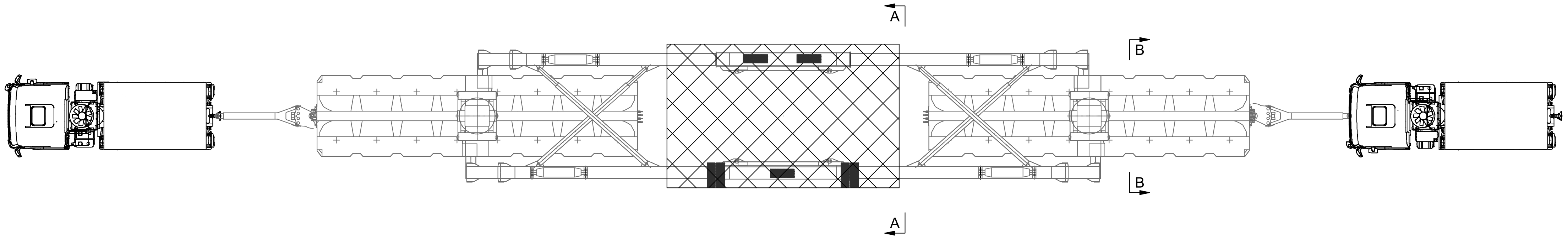
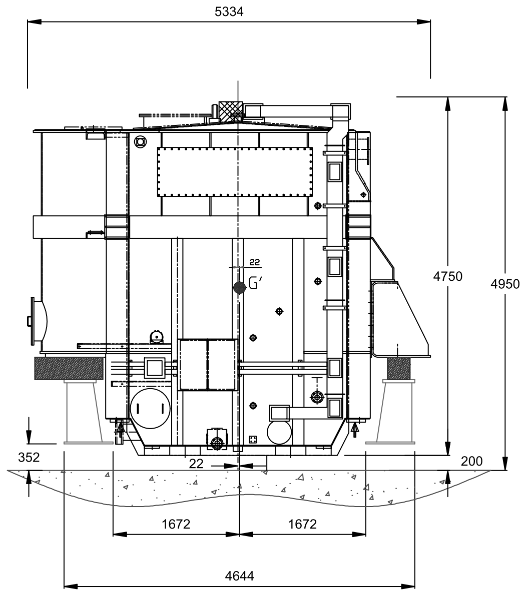


PLAN VIEW
(1:150)



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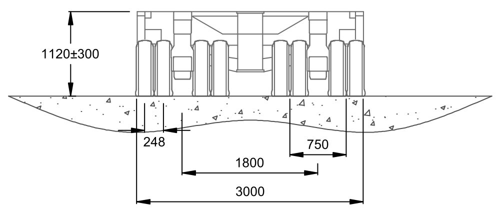

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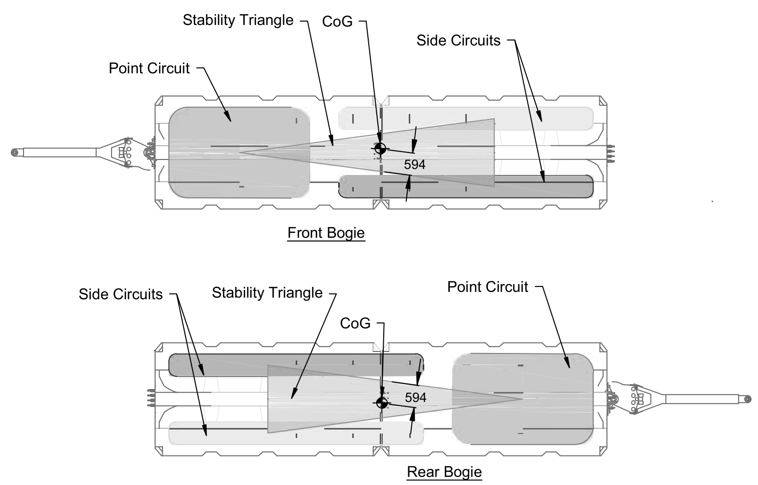

TRAILER STABILITY
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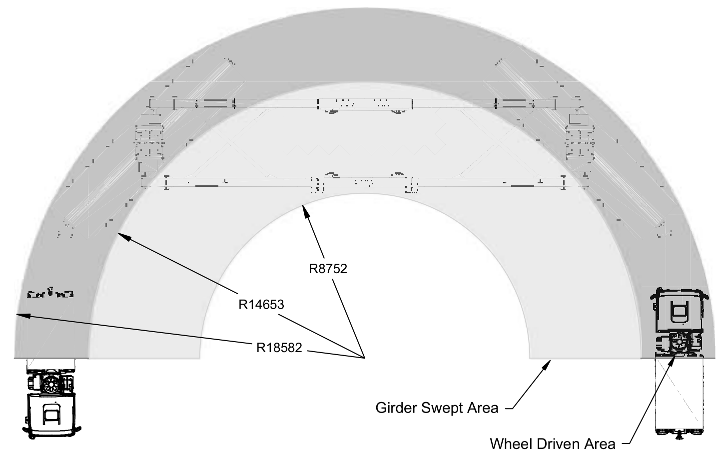


TURNING RADII
(1:400)

DRAWING NOTES:

1. All dimensions are in mm unless otherwise stated
2. All weights are in metric tonnes unless otherwise stated
3. All details are provisional and are subject to confirmation
4. Tractor unit(s) dimensions and axle spacings may vary depending on the type of tractor unit(s) used.

TECHNICAL NOTES:

Load Table

Applied Load Weight (Te)	178.00
Trailer Tare Weight (Te)	86.80
Auxiliary Steel Work (Te)	0.00
Trailer Gross Weight (Te)	264.80
Load per Bogie (Te)	132.40
Load per Axle (Te)	16.55
Block Ground Loading (Te/m²)	3.68

Rev.	Date	Drawn	Ammendments
A	06/12/2018	EDA	Weight Change
0	17/08/2018	EDA	Issued for comment

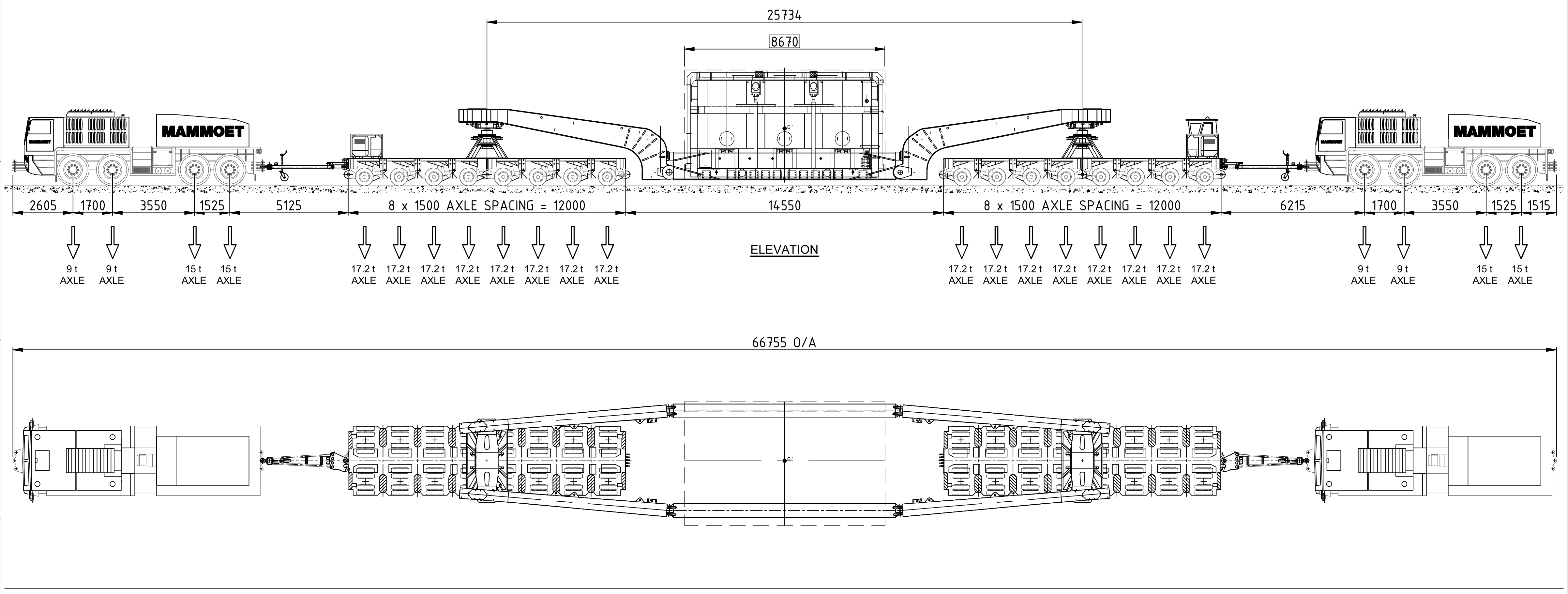
Revisions

Allelys Group
The Slough,
Studley,
Warwickshire,
B80 7EN
Tel: +44 (0) 1527 852 408
e-mail: enquiries@allelys.co.uk

Client	Wynns
Project	Taunton
Title	178 Te Transformer 16 Axle Girder Frame Transport Arrangement
Scale (A3)	1:100, 1:200, 1:400
Drawn	EDA
Checked	MJC
Dwg. No	WWPN-18-049-00
Sheet	1 of 1
Revision	A

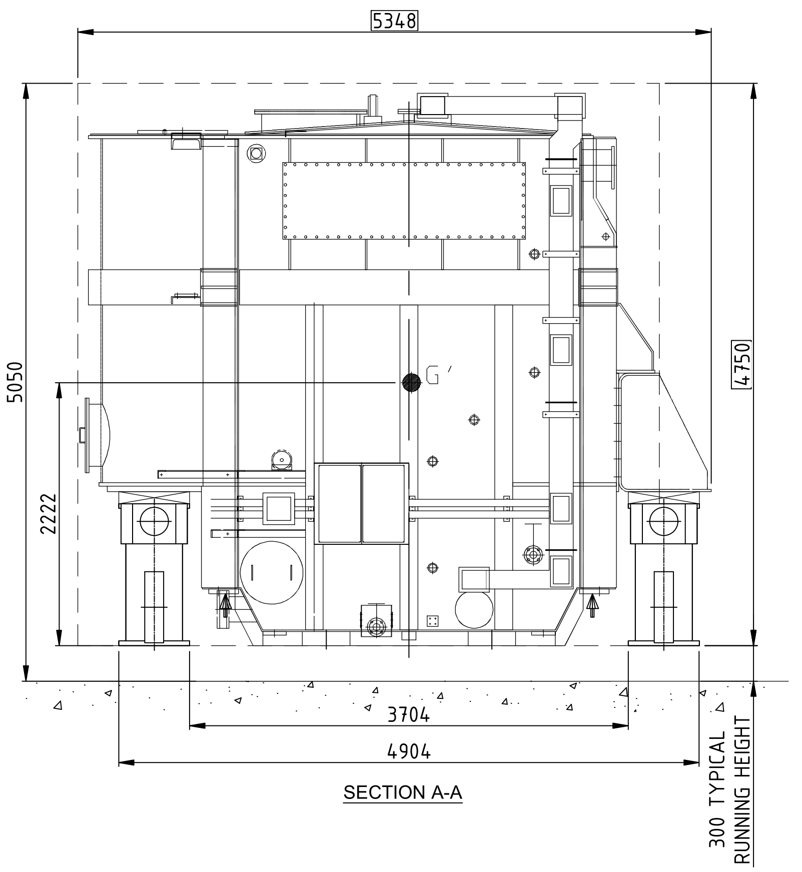
DO NOT SCALE

IF IN DOUBT ASK

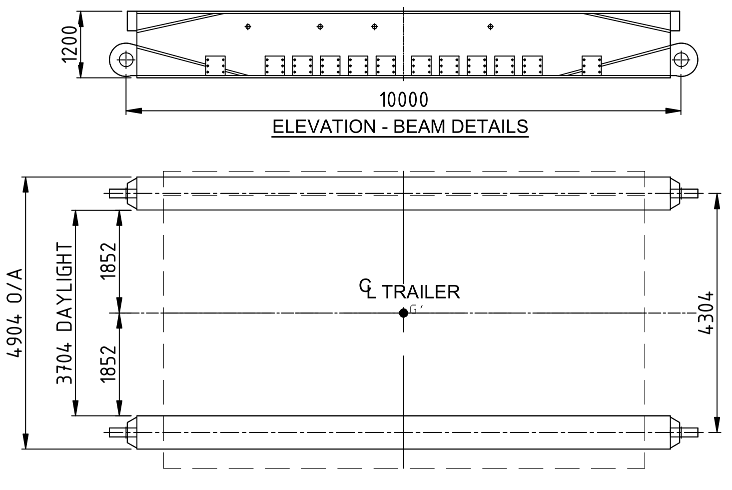


ELEVATION

PLAN VIEW

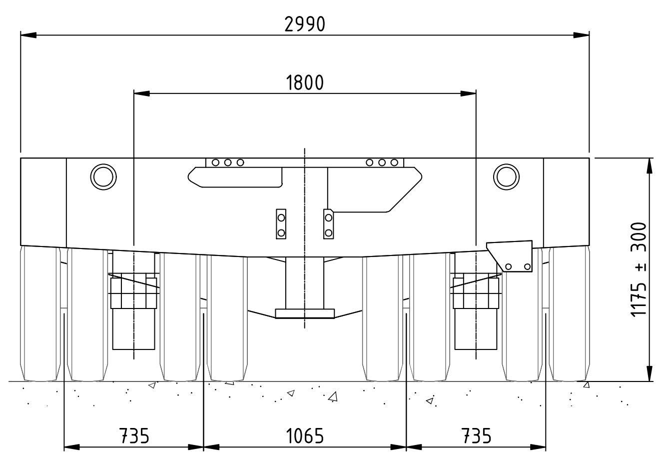


SECTION A-A



ELEVATION - BEAM DETAILS

PLAN VIEW - BEAM DETAILS



END ELEVATION TRAILER DETAIL

TRAILER SPECIFICATION	
AL50 (16 AXLE) 10m BEAM	
all weights in t (metric tonnes)	Total
NUMBER OF AXLE LINES	16
NUMBER OF FILES	2
LOAD DETAILS	
PAY LOAD	178
TRANSPORTER WEIGHT	97.2
ENGINE WEIGHT	-
AUXILIARY STEEL WEIGHT	0.0
TOTAL LOAD	275.2
LOAD PER AXLE LINE / TRAILER	17.2
LOAD PER FILE	8.6
LOAD PER WHEEL	2.1
GROUND BEARING PRESSURE t/m²	3.8

TECHNICAL NOTES:-

- SHIPPING DIMENSIONS: 8.67 x 5.348 x 4.75mm (L x W x H) @ 178te.
- ORIENTATION TO BE CONFIRMED BY CLIENT/HYUNDAI.
- **REDUCIBLE HEIGHT OF 4850mm**

GENERAL NOTES	
1	CLIENT IS RESPONSIBLE FOR THE LEVELLING, COMPACTING AND CLEARING OF THE TRANSPORT AREA TO ALLOW TRAILER OPERATIONS.
2	CLIENT IS RESPONSIBLE FOR THE STRUCTURAL INTEGRITY OF THE LOAD TO BE TRANSPORTED.
3	CLIENT TO CONFIRM SUITABILITY OF SUPPORT POINTS DESIGNATED IN THIS DRAWING.
4	SECURE CARGO ONTO TRAILER USING LASHING MATERIAL.
5	ANTI SLIP MATERIAL TO BE USED BETWEEN ALL STEEL-STEEL CONTACT AREAS TO INCREASE FRICTION.
6	SUPERVISOR CAN MAKE MINOR FIELD ADJUSTMENTS TO PLAN

REFERENCE DRAWINGS		
REF	DRAWING NUMBER	REV
00		

DRAWING STATUS

ISSUED FOR INFORMATION

REV.	DESCRIPTION:	DATE:	DRAWN:	CHECKED:
00	First Issue	31/01/2022	PCox 920939	ACam 920525

Without authorized signatures this document is uncontrolled, not binding and for indicative purposes only.

CLIENT:

PROJECT: CELLARHEAD

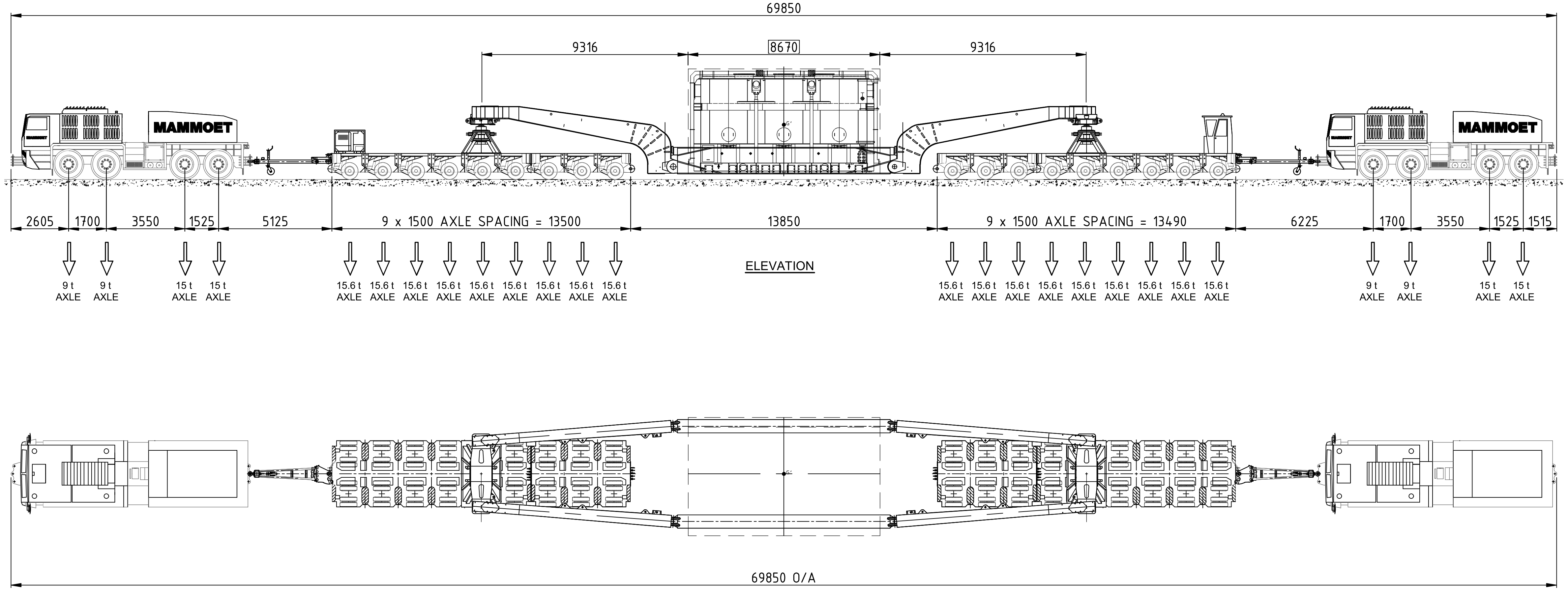
TITLE: 178Te TRANSFORMER
AL50 16 AXLE TRANSPORT ARRANGEMENT
HYUNDAI 400/132KV 240MVA

MAMMOET

Mammoet UK LTD. - Maxima House, Earlsway
Thornaby on Tees, Stockton, TS17 9JU, United Kingdom
Tel. +44(0)1642 366 150 / Fax. +44(0)164 361 738
www.mammoet.com

SCALE: N.T.S. SIZE: DRAWING NUMBER

SAP No:	PROJECT No:	SUB:	DOC:	PART:	SHT.	REV.
7000257402		-	- D -	T01 -	1/1 -	00



ELEVATION

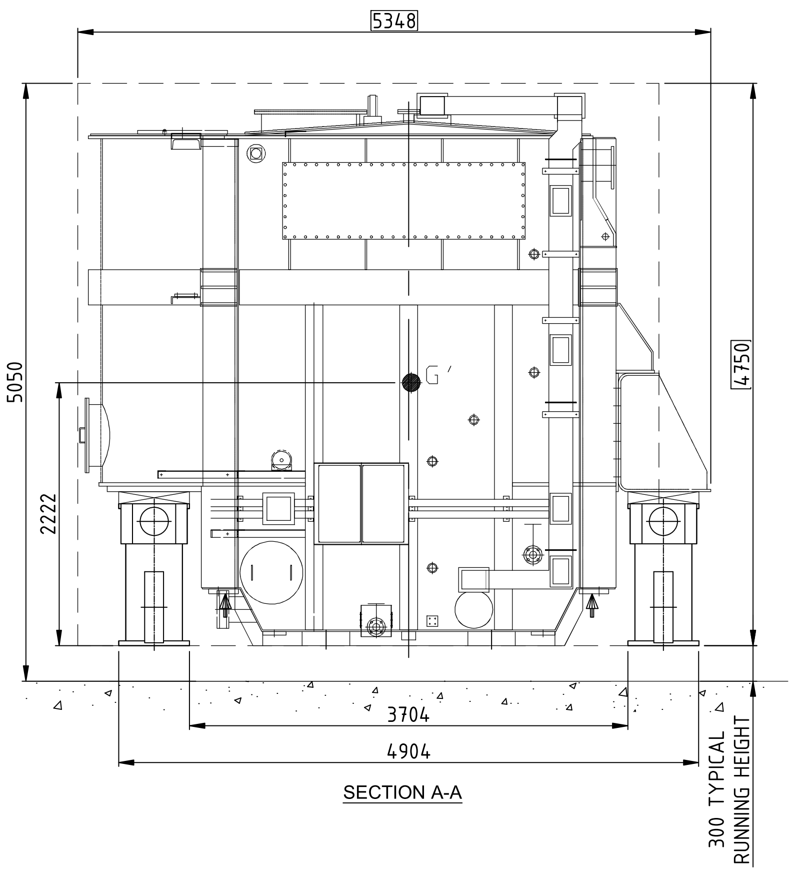
PLAN VIEW

TRAILER SPECIFICATION

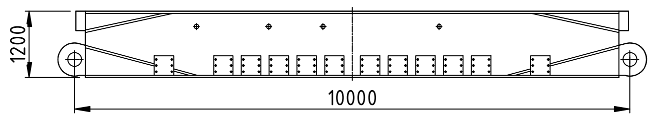
AL50 (18 AXLE) 10m BEAM	
all weights in t (metric tonnes)	Total
NUMBER OF AXLE LINES	18
NUMBER OF FILES	2
LOAD DETAILS	
PAY LOAD	178
TRANSPORTER WEIGHT	103.2
ENGINE WEIGHT	-
AUXILIARY STEEL WEIGHT	0.0
TOTAL LOAD	281.2
LOAD PER AXLE LINE / TRAILER	15.6
LOAD PER FILE	7.8
LOAD PER WHEEL	1.9
GROUND BEARING PRESSURE t/m²	3.48

TECHNICAL NOTES:-

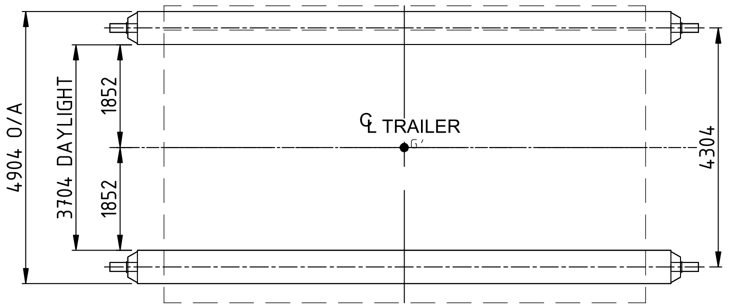
- SHIPPING DIMENSIONS: 8.67 x 5.348 x 4.75mm (L x W x H) @ 178te.
- ORIENTATION TO BE CONFIRMED BY CLIENT/HYUNDAI.
- **REDUCIBLE HEIGHT OF 4850mm**



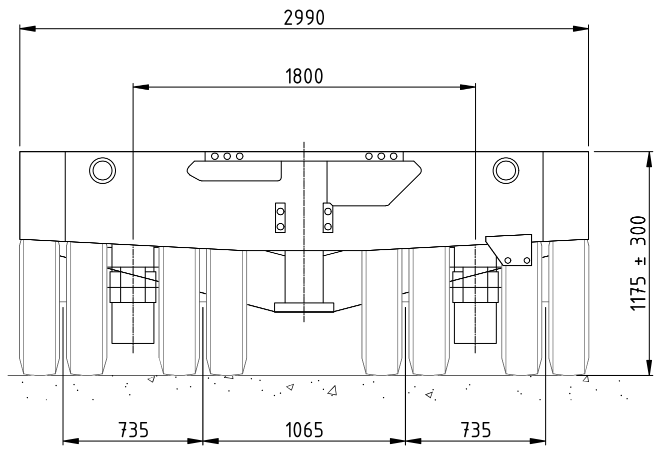
SECTION A-A



ELEVATION - BEAM DETAILS



PLAN VIEW - BEAM DETAILS



END ELEVATION TRAILER DETAIL

GENERAL NOTES

1	CLIENT IS RESPONSIBLE FOR THE LEVELLING, COMPACTING AND CLEARING OF THE TRANSPORT AREA TO ALLOW TRAILER OPERATIONS.
2	CLIENT IS RESPONSIBLE FOR THE STRUCTURAL INTEGRITY OF THE LOAD TO BE TRANSPORTED.
3	CLIENT TO CONFIRM SUITABILITY OF SUPPORT POINTS DESIGNATED IN THIS DRAWING.
4	SECURE CARGO ONTO TRAILER USING LASHING MATERIAL.
5	ANTI SLIP MATERIAL TO BE USED BETWEEN ALL STEEL-STEEL CONTACT AREAS TO INCREASE FRICTION.
6	SUPERVISOR CAN MAKE MINOR FIELD ADJUSTMENTS TO PLAN

REFERENCE DRAWINGS

REF	DRAWING NUMBER	REV
00		

DRAWING STATUS

ISSUED FOR INFORMATION

REV.	DESCRIPTION:	DATE:	DRAWN:	CHECKED:
00	First Issue	31/01/2022	PCox 920939	ACam 920525

Without authorized signatures this document is uncontrolled, not binding and for indicative purposes only.

CLIENT:

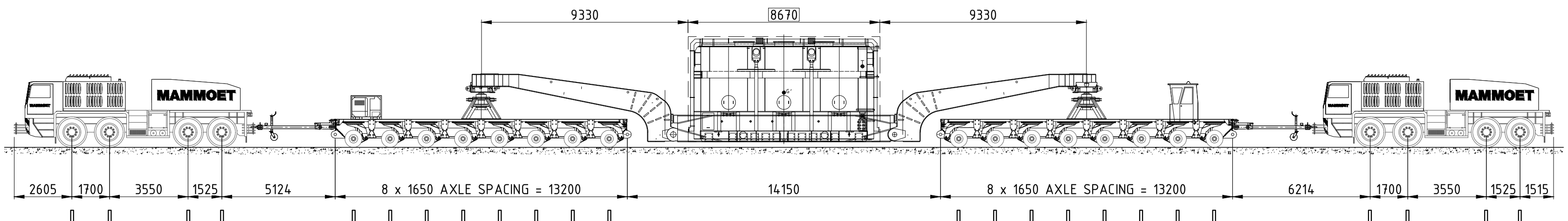
PROJECT: CELLARHEAD

TITLE: 178Te TRANSFORMER
AL50 18 AXLE TRANSPORT ARRANGEMENT
HYUNDAI 400/132KV 240MVA

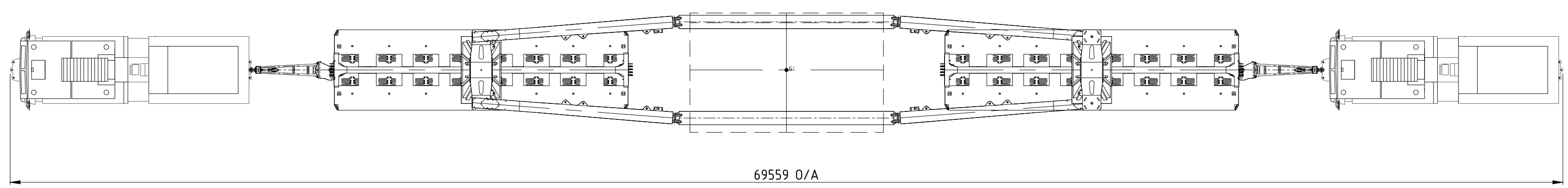
MAMMOET
Mammoet UK LTD. - Maxima House, Earlsway
Thornaby on Tees, Stockton, TS17 9JU, United Kingdom
Tel. +44(0)1642 366 150 / Fax. +44(0)164 361 738
www.mammoet.com

SCALE: N.T.S. SIZE: DRAWING NUMBER

SAP No:	PROJECT No:	SUB:	DOC:	PART:	SHT.	REV.
7000257399		-	-D-	T01	- 1/1	- 00



ELEVATION

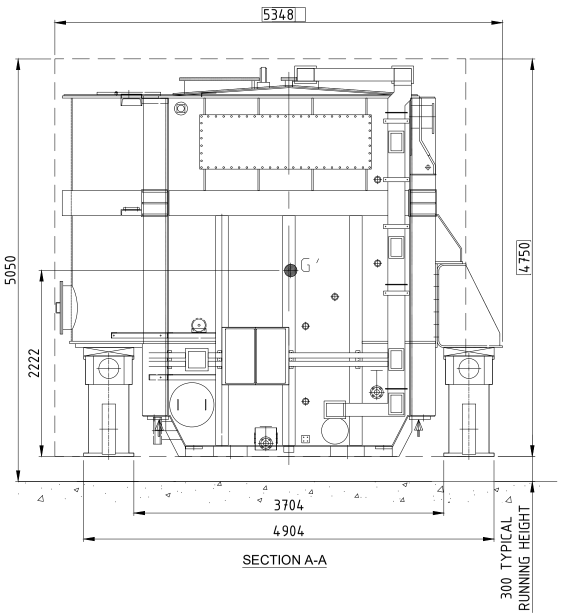


PLAN VIEW

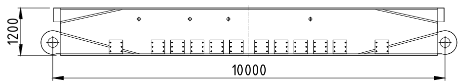
TRAILER SPECIFICATION	
AL50 (16 WIDENING AXLE) 10m BEAM	
all weights in t (metric tonnes)	Total
NUMBER OF AXLE LINES	16
NUMBER OF FILES	2
LOAD DETAILS	
PAY LOAD	178
TRANSPORTER WEIGHT	101.6
ENGINE WEIGHT	-
AUXILIARY STEEL WEIGHT	0.0
TOTAL LOAD	279.6
LOAD PER AXLE LINE / TRAILER	17.46
LOAD PER FILE	8.73
LOAD PER WHEEL	2.18
GROUND BEARING PRESSURE t/m²	2.94

TECHNICAL NOTES:-

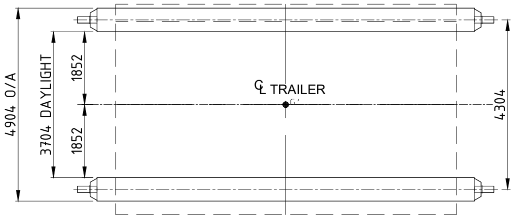
- SHIPPING DIMENSIONS: 8.67 x 5.348 x 4.75mm (L x W x H) @ 178te.
- ORIENTATION TO BE CONFIRMED BY CLIENT/HYUNDAI.
- **REDUCIBLE HEIGHT OF 4850mm**



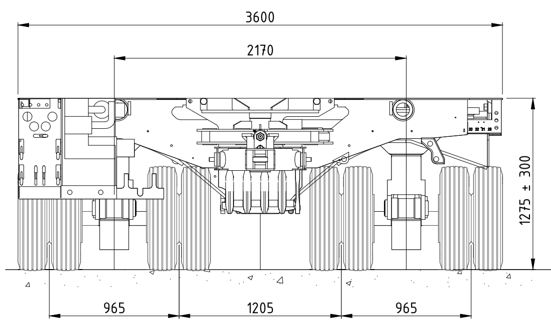
SECTION A-A



ELEVATION - BEAM DETAILS



PLAN VIEW - BEAM DETAILS



END ELEVATION
TRAILER DETAIL

GENERAL NOTES	
1	CLIENT IS RESPONSIBLE FOR THE LEVELLING, COMPACTING AND CLEARING OF THE TRANSPORT AREA TO ALLOW TRAILER OPERATIONS.
2	CLIENT IS RESPONSIBLE FOR THE STRUCTURAL INTEGRITY OF THE LOAD TO BE TRANSPORTED.
3	CLIENT TO CONFIRM SUITABILITY OF SUPPORT POINTS DESIGNATED IN THIS DRAWING.
4	SECURE CARGO ONTO TRAILER USING LASHING MATERIAL.
5	ANTI SLIP MATERIAL TO BE USED BETWEEN ALL STEEL-STEEL CONTACT AREAS TO INCREASE FRICTION.
6	SUPERVISOR CAN MAKE MINOR FIELD ADJUSTMENTS TO PLAN

REFERENCE DRAWINGS		
REF	DRAWING NUMBER	REV
00		

DRAWING STATUS

ISSUED FOR INFORMATION

REV.	DESCRIPTION:	DATE:	DRAWN:	CHECKED:
00	First Issue	08/03/2022	PCox 920939	ACam 920525

Without authorized signatures this document is uncontrolled, not binding and for indicative purposes only.

CLIENT:

PROJECT: CELLARHEAD

TITLE: 178Te TRANSFORMER
AL50 16 WIDENING AXLE TRANSPORT ARRANGEMENT
HYUNDAI 400/132KV 240MVA

MAMMOET

Mammoet UK LTD. - Maxima House, Earlsway
Thornaby on Tees, Stockton, TS17 9JU, United Kingdom
Tel. +44(0)1642 366 150 / Fax. +44(0)164 361 738
www.mammoet.com

SCALE: N.T.S.	SIZE:	DRAWING NUMBER					
SAP No:	PROJECT No:	SUB:	DOC:	PART:	SHT.	REV.	
7000257398		-	-D-	T01	- 1/1	- 00	

Appendix D – Assessment and Check Certificates

(Form of Certificate to be used by the Design Office for structures in Category 2, which have been given Approval in Principle)

1. We certify that reasonable professional skill and care have been used in the assessment of A131 Town Bridge (ECC Bridge No 43/42624) with a view to securing that:

   i. It has been assessed in accordance with the Approval in Principle dated 10th October 2022, including the following departures:
   Not Applicable

   ii. The assessed capacity of the structure is as follows:

Abnormal vehicles in accordance with AIP; normal speed assumed

Vehicle ref	Tractor	Bogies	Axle weights	PASS/FAIL
Collett 20	40t	2 x 10 axles	15.625t	PASS
Allelys 16	42t	2 x 8 axles	16.55t	PASS
ALE AL50-16	48t	2 x 8 axles	17.2t	PASS
ALE AL50-18	48t	2 x 9 axles	15.6t	PASS
ALE AL50-16w	48t	2 x 8 axles	17.47t	PASS
60t CD – 4AM	49.4t	1 x 4 axles	14.72t	PASS
60t CD – 2AB-4AM	33.5t	1 x 2 axles plus 1 x 4 axles	14.12t	PASS

Signed: [redacted]..............................

Name: Richard Donnet
ASSESSMENT TEAM LEADER

Engineering Qualifications: MEng, CEng, MICE

Signed: [redacted].......................

Name: Gordon Brown
CHIEF OFFICER, DIRECTOR or PARTNER

Name of Organisation: Wallace Stone LLP

Date: ....23/02/2023................................

2. This Certificate is recommended for acceptance by:

Signed: [redacted] …………

Name:…Iain Maiden…………………..………….

Engineering Qualifications: BEng CEng MICE ………………………………………..

Name of Organisation: On behalf of Ringway Jacobs

Date:……………………………………………….

3. This Certificate is accepted by:

Signed:…[redacted]..

Name:…Clive Woodruff…………………..……….

Position held: Structures Manager ………………………………………..

TAA:……Essex County Council……………………

Date:……………………………………………….

(Form of Certificate to be used by the Design Office for structures in Category 2, which have been given Approval in Principle)

1. We certify that reasonable professional skill and care have been used in the check of the assessment of A131 Town Bridge (ECC Bridge No 43/42624) with a view to securing that:

   i. It has been assessed in accordance with the Approval in Principle dated 10th October 2022, including the following departures:
      Not Applicable

   ii. The assessed capacity of the structure is as follows:

Abnormal vehicles in accordance with AIP; normal speed assumed

Vehicle ref	Tractor	Bogies	Axle weights	PASS/FAIL
Collett 20	40t	2 x 10 axles	15.625t	PASS
Allelys 16	42t	2 x 8 axles	16.55t	PASS
ALE AL50-16	48t	2 x 8 axles	17.2t	PASS
ALE AL50-18	48t	2 x 9 axles	15.6t	PASS
ALE AL50-16w	48t	2 x 8 axles	17.47t	PASS
60t CD – 4AM	49.4t	1 x 4 axles	14.72t	PASS
60t CD – 2AB-4AM	33.5t	1 x 2 axles plus 1 x 4 axles	14.12t	PASS

Signed: [redacted]......................

Name: Nigel Greenwood
CHECK TEAM LEADER

Engineering Qualifications: BSc (Hons), CEng, MICE, MIStructE

Signed: ..[redacted]...........................

Name: Tom Rea
CHIEF OFFICER, DIRECTOR or PARTNER

Name of Organisation: Wallace Stone LLP

Date: .....23/02/2023................................

2. This Certificate is recommended for acceptance by:

Signed: [redacted]

Name:……Iain Maiden..………………………….

Engineering Qualifications: …BEng CEng MICE……………………………..

Name of Organisation: …On behalf of Ringway Jacobs

Date:………………………………………………….

3. This Certificate is agreed by:

Signed:……… [redacted]

Name:…Clive Woodruff……………..…………………

Position held: Structures Manager……………………………..

TAA:…Essex County Council………………………

Date:………………………………………………….

Appendix E – Assessment Calculations

Calculation Cover Sheet

Wallace Stone

No. of Sheets 137

Project Title A131 Town Bridge Halstead **Project No.** 2405 **File No.**

Section

Subject AIL Assessment Calculations **Calc No.** 1

Project Manager G Brown

Design Phase
- **A** Concept or preliminary ☐
- **B** Analysis and Detailed design ☐
- **C** Design verification ☐
- **D** Other (specify) Assessment ☐

Designer Richard Donnet

Computer Applications Used

Title
Autodesk Robot Structural Analysis

Version/Date
2022

Scopes of Checking for Manual and Computer Generated Calculations
Category 2 Check – Separate Office

	Sheets Checked	Calculations by Name	Calculations by Signature	Calculations by Date	Checked By Name	Checked By Signature	Checked By Date
5/5	1-137	R Donnet	[redacted]	29/9/22	N/A		
5/5	1-137 RevA	R.DONN [redacted]		1/12/22			
	1-94 RevB	R.DONN [redacted]		23/2/23			

---

a) **Basic Design Information or Source and Reference:**
Record Drawings from 1971
Assessment Report 2010 by Mouchel
PI Report 2022

---

b) **Identify documents/technical records where output will be used:**
AIL Assessment Report

Approved by Project Manager [redacted] ~~Error! Reference~~ **Signatur**[redacted] **Date** 29/9/22

Distribution
Original to project file

Version 0 May 2015

WALLACE STONE	Project : TOWNBRIDGE		
Calculation Sheet	Job No. : 2405	Made By :	RS
Description:	Date : JULY 22.	Checked :	
	Page No.: 1 of		

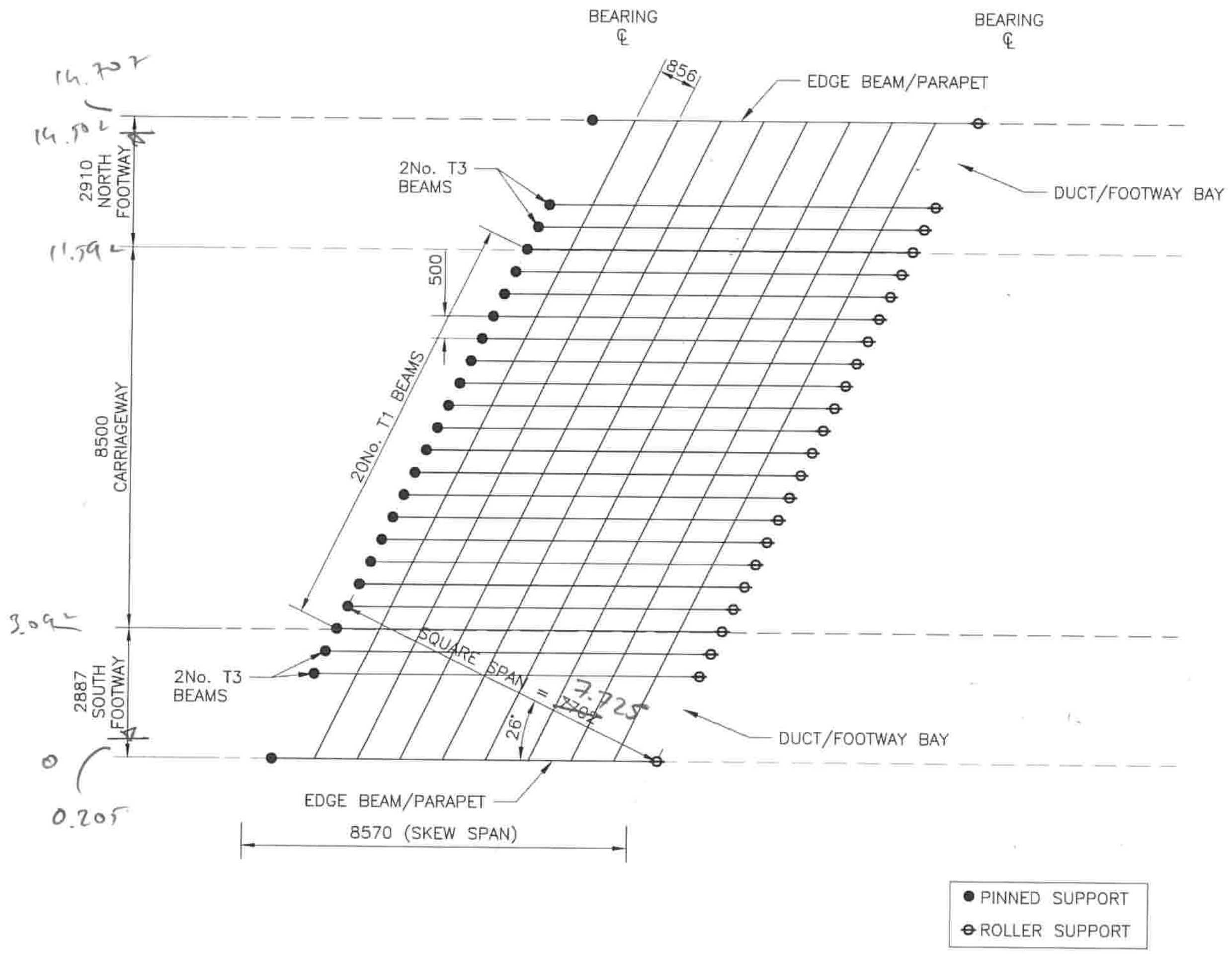
Output

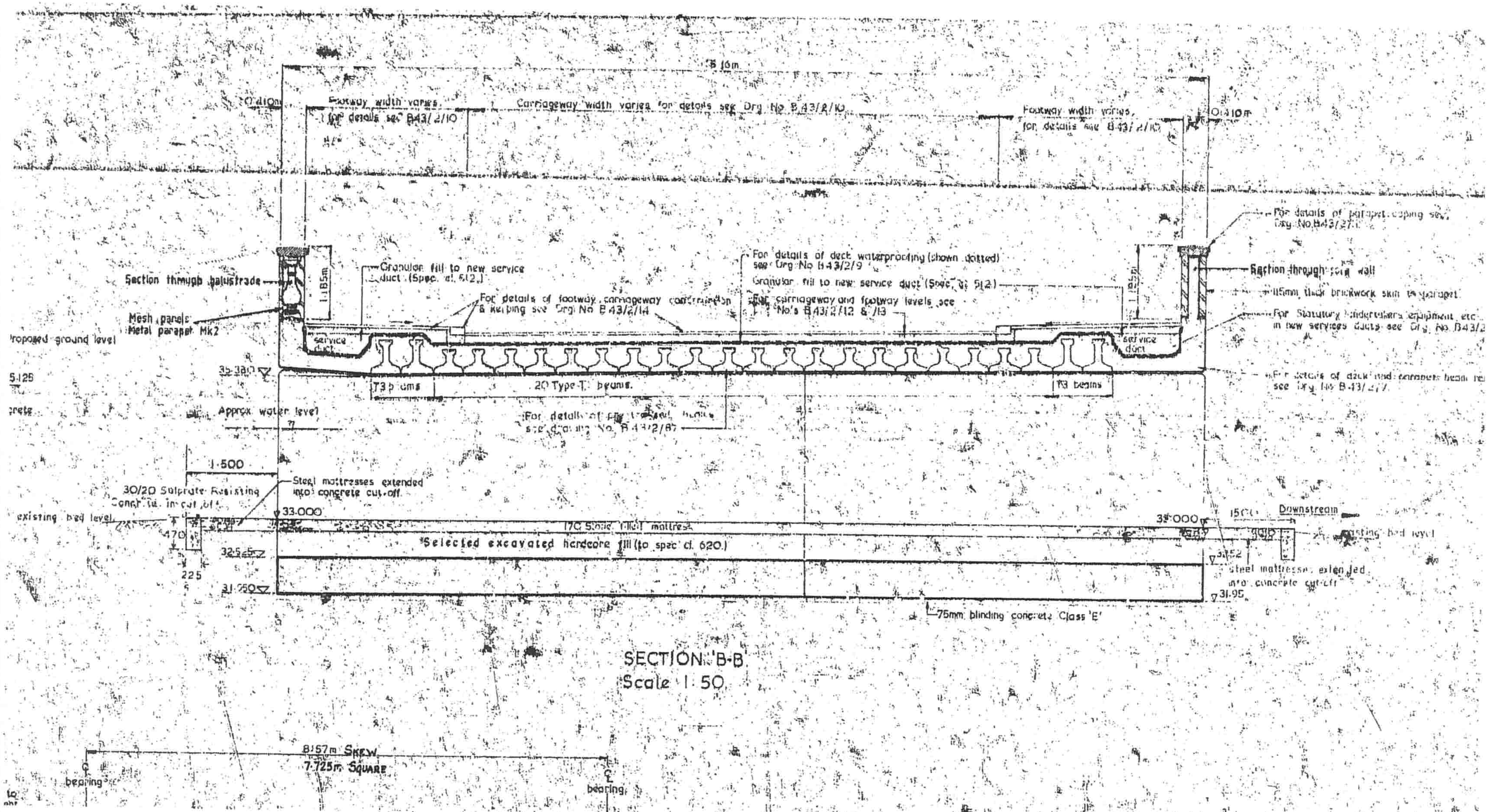
ASSESSMENT OF TOWNBRIDGE, HALSTEAD

- ASSESSMENT OF BRIDGE FOR THE MOVEMENT OF ALL CARRYING A 140T TRANSFORMER FOR SUB-STATION.
- PREVIOUS ASSESSMENT REPORT AVAILABLE (DATED 2010) FOR ALL MOVEMENT WITH A 137 TONNE TRANSFORMER
- PI REPORT DATED JULY 2021
- INSPECTION FOR ASSESSMENT CARRIED OUT BY WALLACE STONE IN MAY 2022

ANNEX B

Grillage Layout Sketch

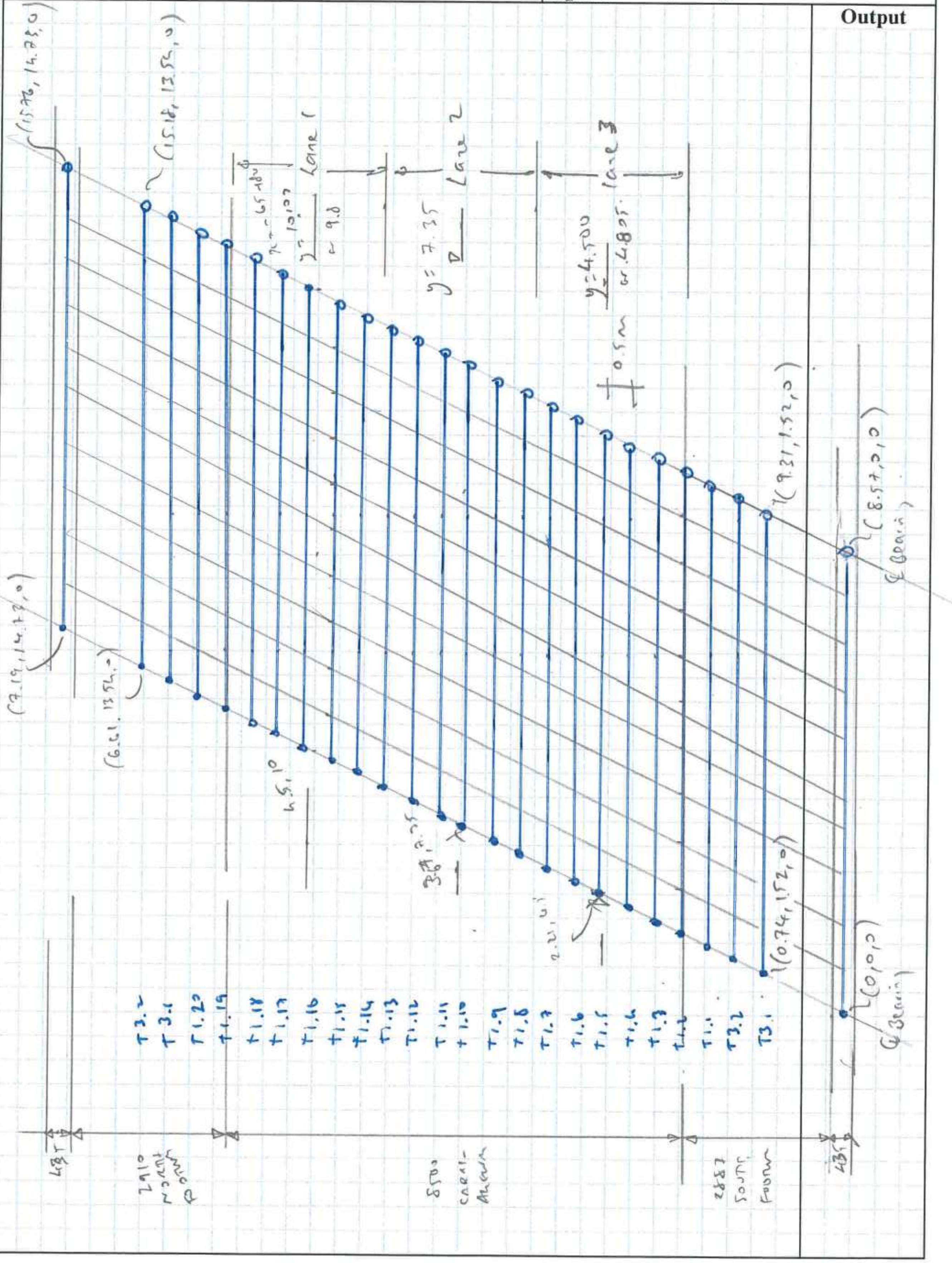




SECTION 'B-B'
Scale 1:50

WALLACE STONE	Project : TOWNBRIDGE		
Calculation Sheet	Job No. : 2405	Made By :	RD
Description:	Date : June 22	Checked :	
	Page No.: 4 of		

Output



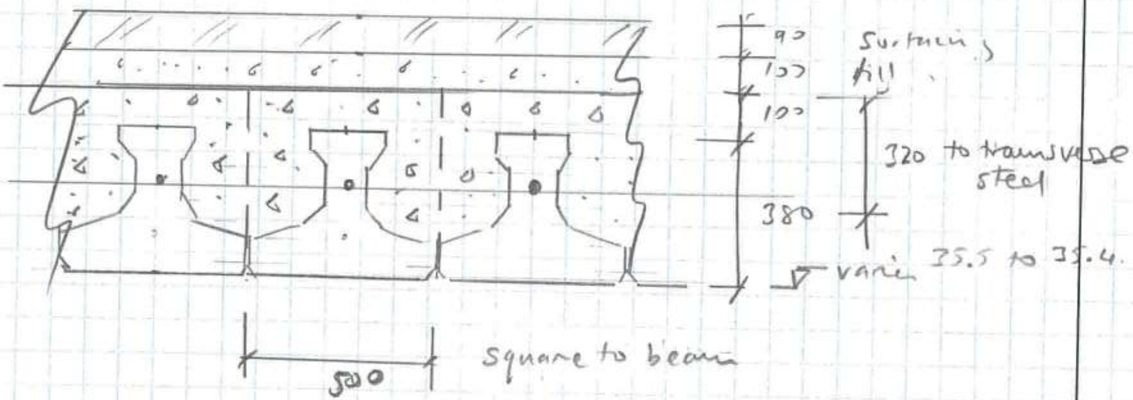
WALLACE STONE	Project : TOWN BRIDGE	
Calculation Sheet	Job No. : 2405	Made By : RJ
Description: TOWN BRIDGE	Date : 12/6/22	Checked :
	Page No.: 5 of	

Output

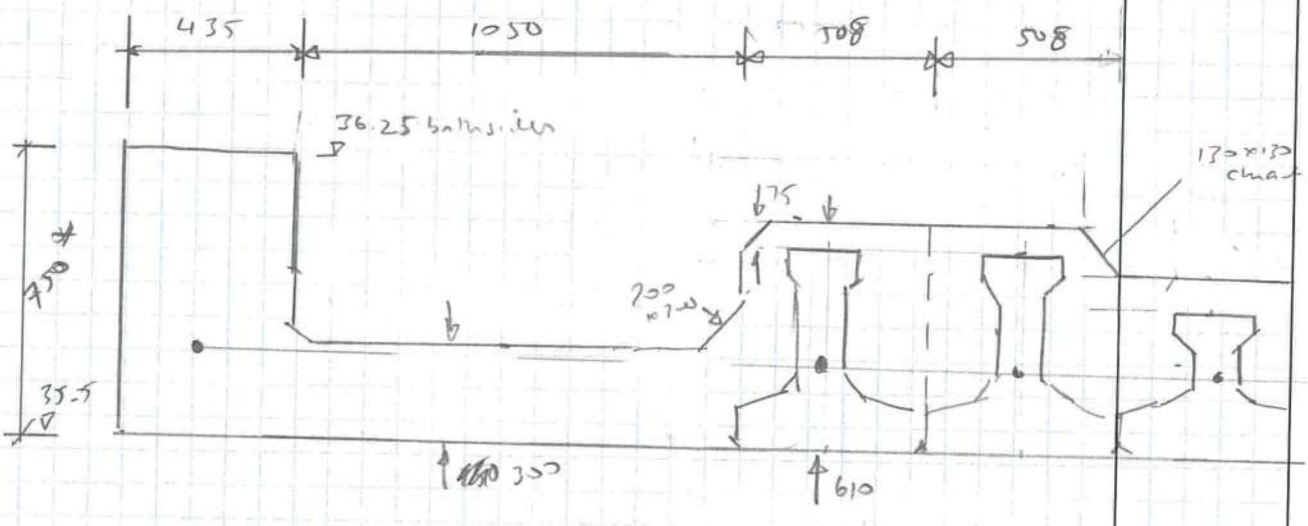
TOWN BRIDGE ASSESSMENT

Geometry

Carriageway



Footway square to beam.



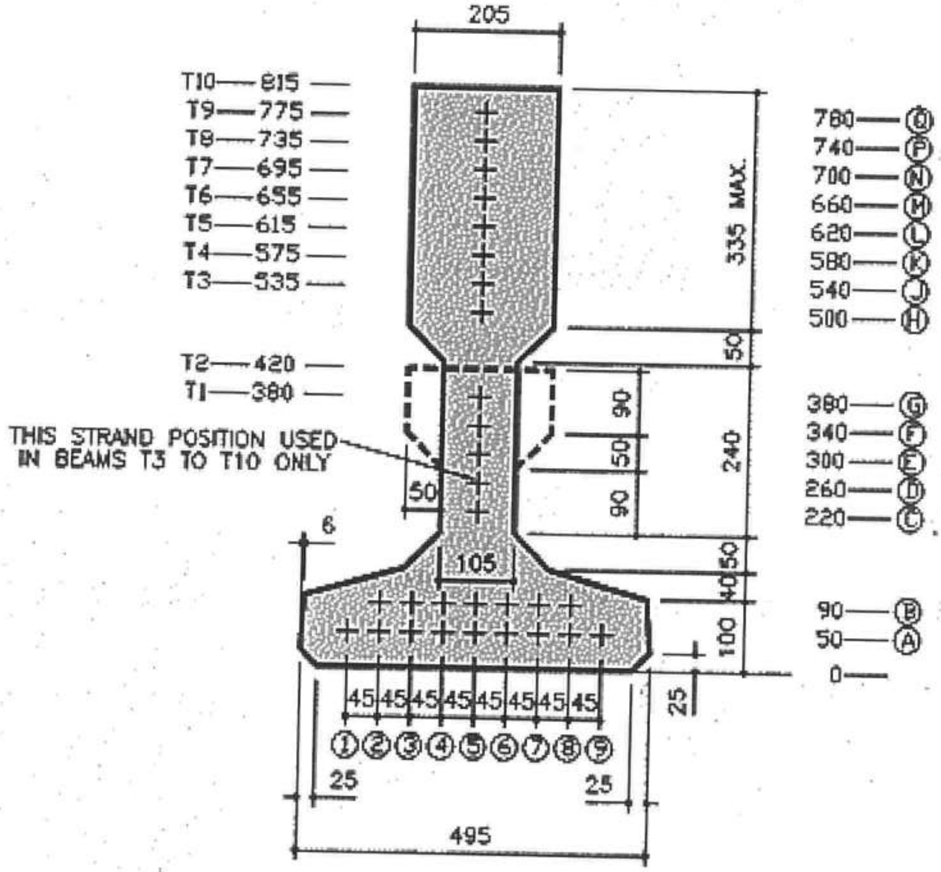
* different each side but keep same for model

T Beam

Suitable for short and medium span applications Tarmac Precast Concrete 'T' beams have been successfully used for many years in a variety of situations requiring solid slab construction including road and access bridges, commercial developments, jetties and other heavily loaded structures. Tarmac Precast Concrete 'T' beams eliminate the need for site formwork and the resulting construction gives a very durable structure.

Typical Applications

Short and medium span DTp bridges, commercial developments, multi-storey car parks, jetties and other heavily loaded structures.



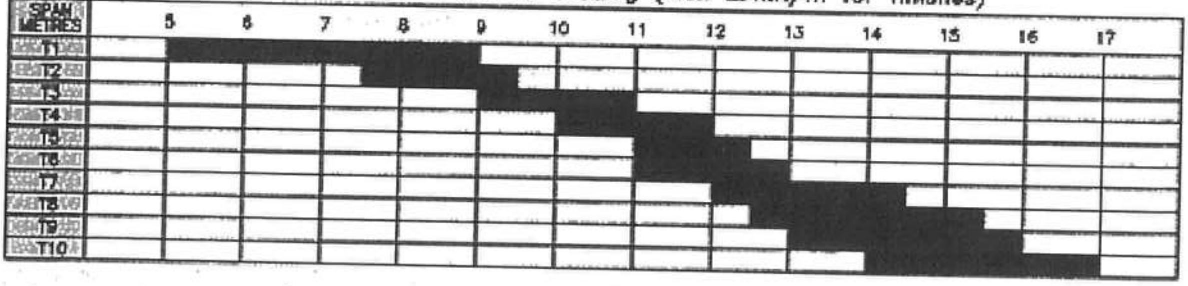
SECTION PROPERTIES

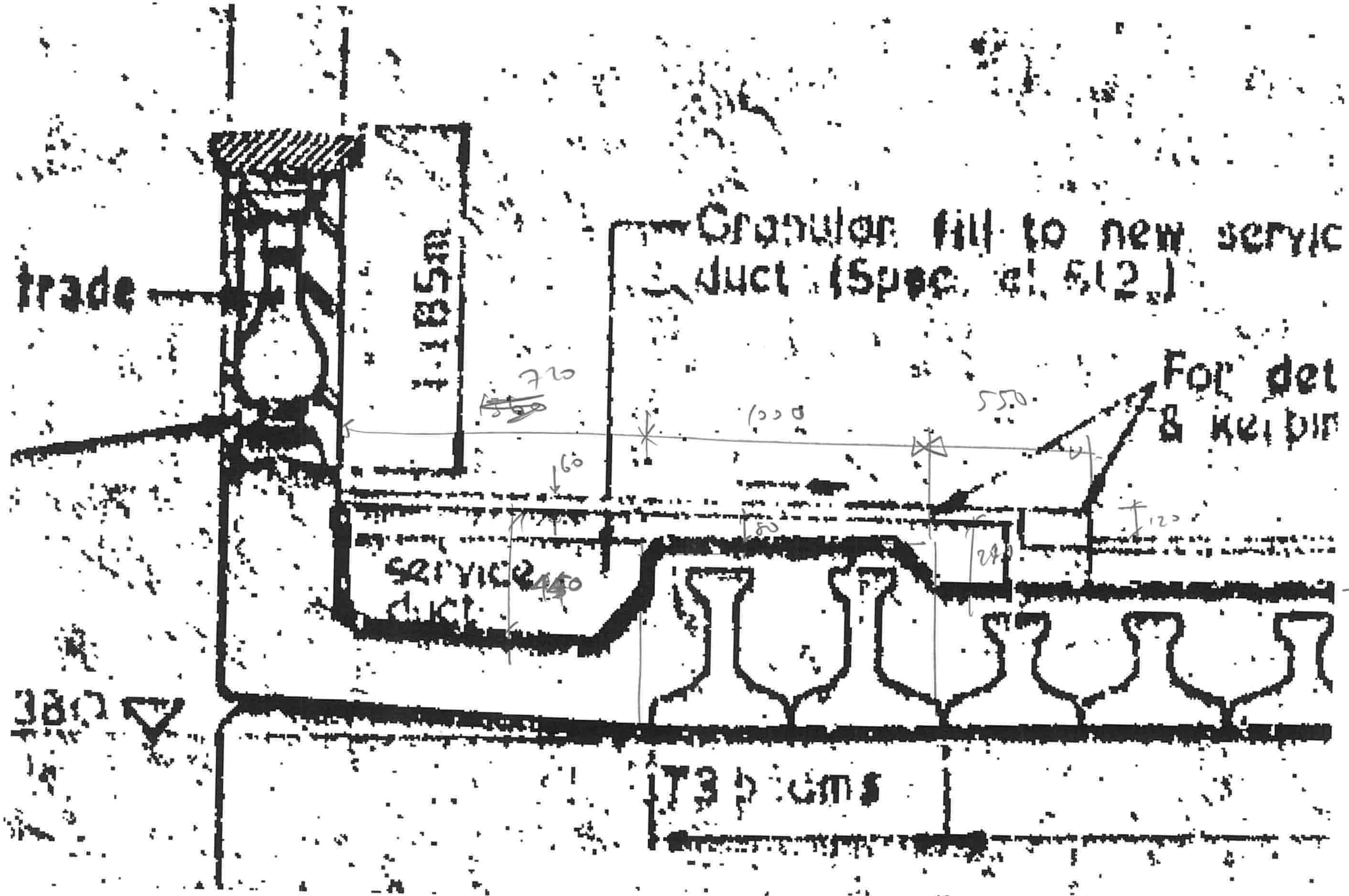
Design self weight per unit volume has been taken as $25kN/m^3$

SECTION No.	DEPTH mm	AREA mm^2	Yb mm	Zt $mm^3 \times 10^6$	Zb $mm^3 \times 10^6$	APP. SELF WEIGHT KN/m
T1	380	97395	140	5.21	8.96	2.45
T2	420	106585	159	6.70	10.95	2.66
T3	535	114180	198	9.57	16.53	2.86
T4	575	122360	220	11.92	19.20	3.06
T5	615	130580	244	14.30	21.78	3.27
T6	655	138760	267	16.73	24.33	3.47
T7	695	146980	289	19.20	26.87	3.68
T8	735	155160	312	21.73	29.44	3.88
T9	775	163380	334	24.32	32.06	4.08
T10	815	171580	356	26.98	34.73	4.29

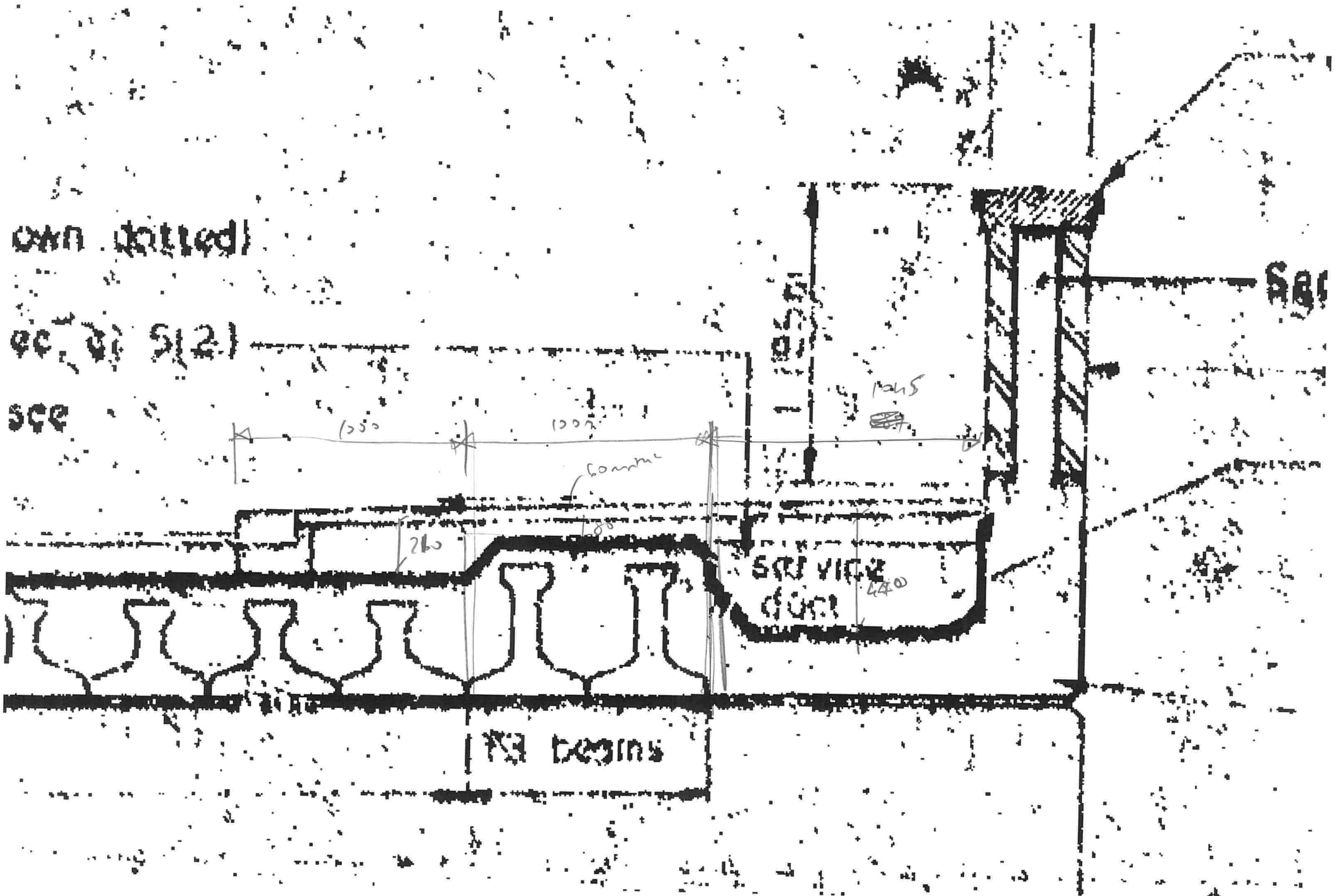
SPAN LOADING

45 units HB Loading (incl. $2.4kN/m^2$ for finishes)





NORTH FOOTWAY



South Fountain

8

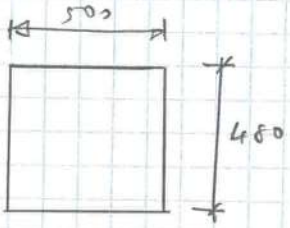
WALLACE STONE	**Project :** TOWNBRIDGE	
Calculation Sheet	**Job No. :** 2405	**Made By :** RJ
Description:	**Date :** JUNE 22	**Checked :**
	Page No.: 9 **of**	

Output

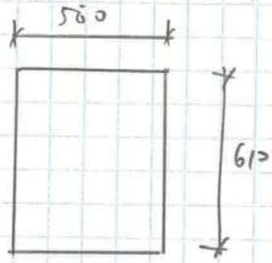
Sections for Model

Longitudinal

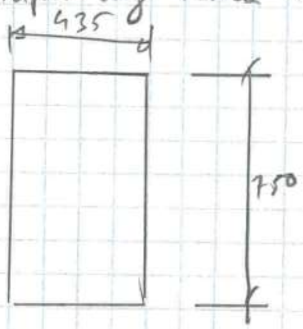
(1) Encased T1 Beam



(2) Encased T3 Beam

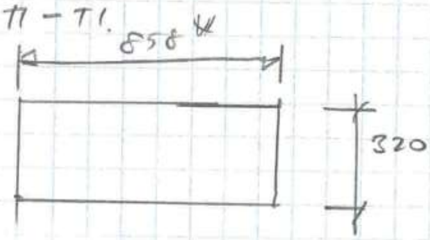


(3) Parapet Edge Beam – assume both side the same

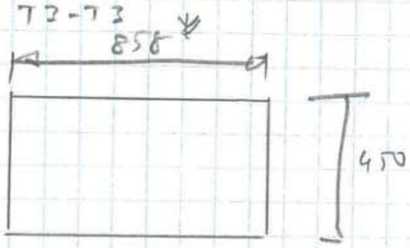


Transverse

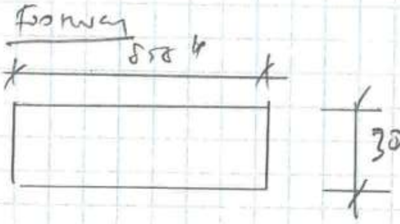
(1) T1 – T1



(2) T3 – T3



(3) Footway



* width halved to 429mm @ supports.

WALLACE STONE	Project :	TOWN BRIDGE		
Calculation Sheet	Job No. :	2405	Made By :	RS
Description:	Date :	JUNE 22	Checked :	
	Page No.:	10 of		

Output

Loading

Permanent loads

(1) Combined beam & infill (T1) = 0.5 × 0.48 × 23.5 = 5.64 kN/m —

Table 4.1.1a CS 454
RC = 2400 kg/m³ = 23.5 kN/m³

γ_{fL} = 1.15 (cl. 3.3)

γ_{f3} = 1.1 (cl 3.7)

(2) Combined beam & infill (T3) = 0.5 × 0.61 × 23.5 = 7.17 kN/m —

γ_{fL} = 1.15 (cl. 3.3)

γ_{f3} = 1.1 (cl 3.7)

(3) Parapet edge beam. = 0.435 × 0.75 × 23.5 = 7.7 kN/m —

(4) Footway transverse = 0.25 × 0.857 × 23.5 = 5.04 kN/m —

(5) Carriageway infill concrete = 0.14 m thick.

T 4.1.1a CS 454
Plain concrete = 2300 kg/m³
= 22.6 kN/m³

γ_{fL} = 1.2 (cl. 3.3)

γ_{f3} = 1.1 (cl. 3.7)

∴ 0.14 × 22.6 = 3.16 kN/m² —

(6) Carriageway surfacing & footway surfacing - 60 mm thick
0.06 × 23.5 = 1.41 kN/m²

T4.1.1a CS 454
Surfacing (Tar) = 2400 kg/m³
= 23.5 kN/m³

γ_{fL} = 1.75 (cl. 3.3)
γ_{f3} = 1.1 (cl 3.7)

(7) Footway infill loads. γ = 22.6 kN/m³. γ_{fL} = 1.2 γ_{f3} = 1.1

(a) 210 mm thick = 0.21 × 22.6 = 4.75 kN/m²

(b) 80 mm thick = 0.08 × 22.6 = 1.81 kN/m²

(c) 440 mm thick = 0.44 × 22.6 = 9.94 kN/m²

(8) Parapet - Masonry (assume solid) =
T 4.1.1a CS 454
Masonry engineered brick = 2300 kg/m³
= 22.6 kN/m³

1.185 × 0.435 × 22.6
= 11.65 kN/m.

γ_{fL} = 1.2 (cl 3.3)
γ_{f3} = 1.1 (cl 3.7)

WALLACE STONE	Project :	Newbront		
Calculation Sheet	Job No. :	2405	Made By :	RS
Description:	Date :	June 22	Checked :	
	Page No.:	11	of	

Output

<u>Loading</u>

Verification of loads applied in Robot model

<u>Self weight</u>

(1) 5.64 kN/m × 8.57m × 21 No = 1015 kN

(2) 7.17 kN/m × 8.57 m × 4 No = 245.8 kN

(3) 7.7 kN/m × 8.57m × 2 No = 132 kN

(4) 5.04 kN/m × 1.69 m × 11 No = 93.7 kN

+ 5.04 kN/m × 1.33 m × 11 No = 73.7 kN

1560.2 kN — Robot 1553.5 kN = 0.43% diff. OK.

<u>Infill concrete</u>

(5) 3.16 kN/m² × 8.57 m × 8.5 m = 230.19 kN

(7)(a) 4.75 kN/m² × 8.57 m × 0.83 m = 33.8 kN

4.75 kN/m² × 8.57 m × 1.19 m = 48.4 kN

(b) 1.81 kN/m² × 8.57 m × 2 m = 31.02 kN

(c) 9.94 kN/m² × 8.57 m × 0.72 m = 61.33 kN

9.94 kN/m² × 8.57 m × 1.07 m = 91.15 kN

495.9 kN — Robot 496.2 = 0.06% diff. ∴ OK

<u>Surfacing</u>

(6) 1.41 kN/m² × 8.57 × 14.31 m = 172.9 kN — Robot 173 kN = 0.05% diff. ∴ OK

<u>Parapet</u>

(8) 11.65 kN/m × 8.57 × 2 No = 199.7 kN — Robot 199.7 kN ∴ OK

ANNEX C

Details of Proposed Transport Vehicles - Transformer

(1) **Collett 20 axle girder frame trailer**
Trailer gross weight 312.5t
Tractor 8t (2.55m) 8t (1.35m) 12t (1.35m) 12t
5.60m drawbar - bogie 10 axles x 15.625t - 1.50m crs (17.09m) bogie 10 axles x 15.625t – 1.50m crs
6.30m drawbar - tractor 8t (2.55m) 8t (1.35m) 12t (1.35m) 12t
3.0m width over wheels

(2) **Allelys 16 axle girder frame**
Trailer gross weight 264.8t
Tractor 8t (2.602m) 10t (1.44m) 12t (1.42m) 12t
5.455m drawbar - bogie 8 axles x 16.55t – 1.50m (12.455m) bogie 8 axles x 16.55t – 1.50m
5.94m drawbar - tractor 8t (2.602m) 10t (1.44m) 12t (1.42m) 12t
3.0m width over wheels

(3) **ALE AL50-16 axle girder frame**
Trailer gross weight 275.2t
Tractor 9t (1.70m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 8 axles x 17.2t - 1.5m (16.05m) bogie 8 axles x 17.2t -1.5m
6.970m drawbar - tractor 9t (1.70m) 9t (3.55m) 15t (1.525m) 15t
3.00m width over wheels (2.70m over tractor wheels)

(4) **ALE AL50-18 axle girder frame**
Trailer gross weight 281.2t
Tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 9 axles x 15.6t - 1.5m (15.35m) bogie 9 axles x 15.6t -1.5m
6.970m drawbar - tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
3.00m width over wheels (2.70m over tractor wheels)

(5) **ALE AL50-16 axle girder frame (widening)**
Trailer gross weight 279.6t
Tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
5.875m drawbar - bogie 8 axles x 17.47t - 1.65m (14.85m) bogie 8 axles x 17.47t -1.65m
6.970m drawbar - tractor 9t (1.71m) 9t (3.55m) 15t (1.525m) 15t
3.6m (or 4.3m) width over wheels (2.70m over tractor wheels)

(see vehicle drawings on pages following)

(6) 60t Cable drum – 4 axle modules.

(7) 60t Cable drum – 2 axle set – 4 axle module trailer.

WALLACE STONE	Project :	Townbridge		
Calculation Sheet	Job No. :	2405	Made By :	RD
Description:	Date :	June 22	Checked :	
	Page No.:	13	of	

Output

Abnormal loads

- see pages from Aipover

(1) Collette 20 axle Girder Frame

Axle loads - 8t = 78.5 kN

DAF = $1.7\left(\frac{78.5}{10}\right)^{-0.15} = 1.25$

OF = 1.1

$\therefore 78.5 \times 1.1 \times 1.25 = \underline{107.94 \text{ kN}}$

Axle load - 12t = 117.72 kN

DAF = $1.7\left(\frac{117.72}{10}\right)^{-0.15} = 1.17$

OF = 1.1

$\therefore 117.72 \times 1.1 \times 1.17 = \underline{151.51 \text{ kN}}$

Axle load - 15.625 t = 153.28 kN

DAF = $1.7\left(\frac{153.28}{10}\right)^{-0.15} = 1.13$

OF = 1.1 or 1.2

$\therefore$ normal $= 153.28 \times 1.1 \times 1.13 = \underline{190.5 \text{ kN}}$

critical $= 153.28 \times 1.2 \times 1.13 = \underline{207.9 \text{ kN}}$

(2) Allelys 16 axle girder Frame

Axle load = 10t = 98.1 kN

DAF = $1.7 \times \left(\frac{98.1}{10}\right)^{-0.15} = 1.21$

OF = 1.1

$\therefore 98.1 \times 1.1 \times 1.21 = \underline{130.6 \text{ kN}}$

Axle load = 12t (as vehicle above)

Axle load = 16.55t = 162.4 kN

DAF = $1.7 \times \left(\frac{162.4}{10}\right)^{-0.15} = 1.12$

OF = 1.1 or 1.2

normal

$\therefore 162.4 \times 1.1 \times 1.12 = \underline{200.1 \text{ kN}}$

critical

$162.4 \times 1.2 \times 1.12 = \underline{218.3 \text{ kN}}$

WALLACE STONE Calculation Sheet	Project :	TOWNBRIDGE		
Description:	Job No. :	7405	Made By :	ND
	Date :	JUN 22	Checked :	
	Page No.:	14	of	

Output

Abnormal loads

(3) ALE/MAMMOET AL50- 16 axle girder frame

Axle load = 9t = 88.29 kN

$DAF = 1.7\left(\frac{88.29}{10}\right)^{-0.15} = 1.23$

OF = 1.1

∴ 88.29 × 1.1 × 1.23
= 133 kN

Axle load = 15t = 147.15 kN

$DAF = 1.7\left(\frac{147.15}{10}\right)^{-0.15} = 1.14$

OF = 1.1

∴ 147.15 × 1.1 × 1.14
= 184.5 kN

Axle load = 17.2t = 168.7 kN

$DAF = 1.7\left(\frac{168.7}{10}\right)^{-0.15} = 1.11$

OF = 1.1 or 1.2

∴ normal
= 168.7 × 1.1 × 1.11
= 206 kN

Critical
= 168.7 × 1.2 × 1.11
= 224.7 kN

(4) ALE/MAMMOET AL50-18 axle girder frame

Axle load 9t & 15t same as previous vehicle

Axle load = 15.6t = 153 kN

$DAF = 1.7\left(\frac{153}{10}\right)^{-0.15} = 1.13$

OF = 1.1 or 1.2

∴ normal
= 153 × 1.1 × 1.13
= 190.2 kN

Critical
= 153 × 1.2 × 1.13
= 207.5 kN

WALLACE STONE	**Project :** TUNBRIDGE		
Calculation Sheet	**Job No. :** 2405	**Made By :**	RD
Description:	**Date :** JUNE 22	**Checked :**	
	Page No.: 15 **of**		

Output

Abnormal loads

(5) ALF/MAMMOET AL50-16 axle girder frame

Axle load = 9t & 15t (as previous vehicles)

Axle load = 17.47t = 171.4 kN

$DAF = 1.7\left(\frac{171.4}{10}\right)^{-0.15} = 1.11$

∴ normal
$= 171.4 \times 1.1 \times 1.11$
$= \underline{209.3 \text{ kN}}$

OF = 1.1 or 1.2

$= 171.4 \times 1.2 \times 1.11$
$= \underline{228.3 \text{ kN}}$

WALLACE STONE	Project : TOWNBRIDGE	
Calculation Sheet	Job No. : 2405	Made By : RS
Description:	Date : JUNE 22	Checked :
	Page No.: 16 of	

Output

Abnormal loads

(6) 60t cable drum – 4 axle modular

Axle load = 6.4t = 62.8 kN

DAF = 1.7 (62.8 / 10)^-0.15 = 1.29

OF = 1.1

∴ 62.8 × 1.1 × 1.29
= 89.1 kN

Axle load = 10t = 98.1 kN

DAF = 1.7 (98.1 / 10)^-0.15 = 1.21

OF = 1.1

∴ 98.1 × 1.1 × 1.21
= 130.6 kN

Axle load = 16.5t = 161.9 kN

DAF = 1.7 (161.9 / 10)^-0.15 = 1.12

OF = 1.1

∴ 161.9 × 1.1 × 1.12
= 199.5 kN

Axle load = 14.72 = 144.4 kN

DAF = 1.7 (144.4 / 10)^-0.15 = 1.14

OF = 1.1 ~ 1.2

∴ normal
= 144.4 × 1.1 × 1.14
= 181.1 kN

critical
= 144.4 × 1.2 × 1.14
= 197.6 kN

Output

Abnormal loads

(7) 60t cable drum - 2 axle bed - 4 axle modular trailer

Axle load = 8.1t = 79.46 kN

$DAF = 1.7\left(\frac{79.46}{10}\right)^{-0.15} = 1.25$

OF = 1.1

∴ 79.46 × 1.1 × 1.25
= 109.3 kN

Axle load = 12.7t = 124.6 kN

$DAF = 1.7\left(\frac{124.6}{10}\right)^{-0.15} = 1.16$

OF = 1.1

∴ = 124.6 × 1.1 × 1.16

= 159 kN

Axle load = 14.12t = 138.5 kN

$DAF = 1.7\left(\frac{138.5}{10}\right)^{-0.15} = 1.15$

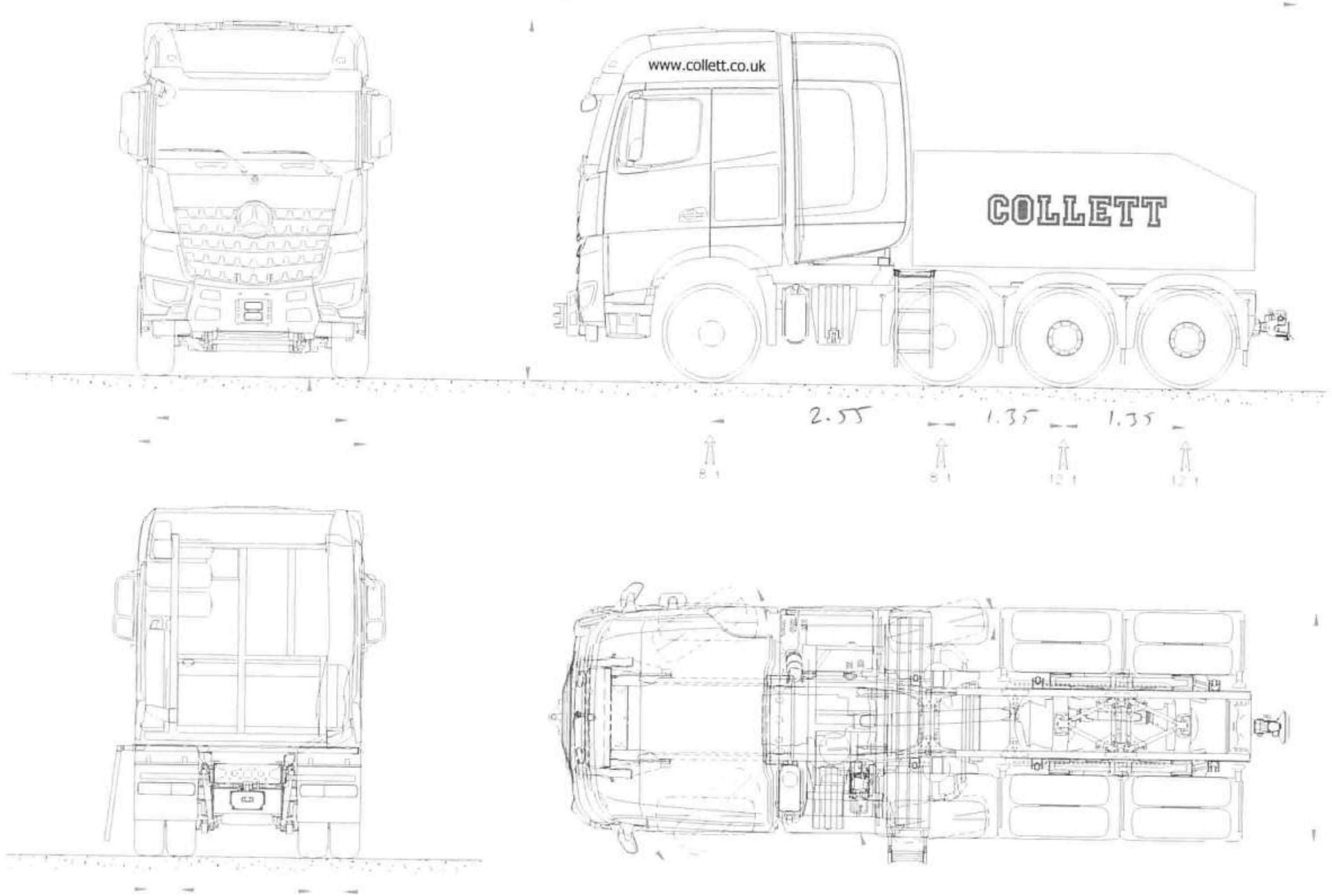
OF = 1.1 ~ 1.2

normal
= 138.5 × 1.1 × 1.15
= 175.2 kN

Critical
= 138.5 × 1.2 × 1.15
= 191.1 kN

As per the AIP - DAF can be omitted for low speed running in the first instance however confirm suitability with DAF and OF as per the code first

Tyre Sizes	
Axle Line	Tyres
1.	385/65 R22.5
2.	385/65 R22.5
3.	315/80 R22.5
4.	315/80 R22.5



For Information

1. THIS DRAWING IS RELEASED FOR INFORMATION ONLY.
2. ALL DIMENSIONS ARE IN MILLIMETRES (mm) UNLESS OTHERWISE STATED.
3. ALL WEIGHTS ARE IN METRIC TONNES (t) UNLESS OTHERWISE STATED.
4. ALL EQUIPMENT IS SUPPLIED IN ACCORDANCE WITH COLLETT & SONS LIMITED TERMS AND CONDITIONS, AND THE RELEVANT R.H.A. 2009 TERMS AND CONDITIONS.
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Rev:	Drawn by:	Date: 2018	Checked by:	Date:
00	Description:			
Client:				
Project:				
Title:	Mercedes 8x4 Ballast Truck			

COLLETT
EXPERTS IN MOTION

COLLETT & SONS LTD
Mistral Point
A.W Nielsen Road
Goole
East Yorkshire
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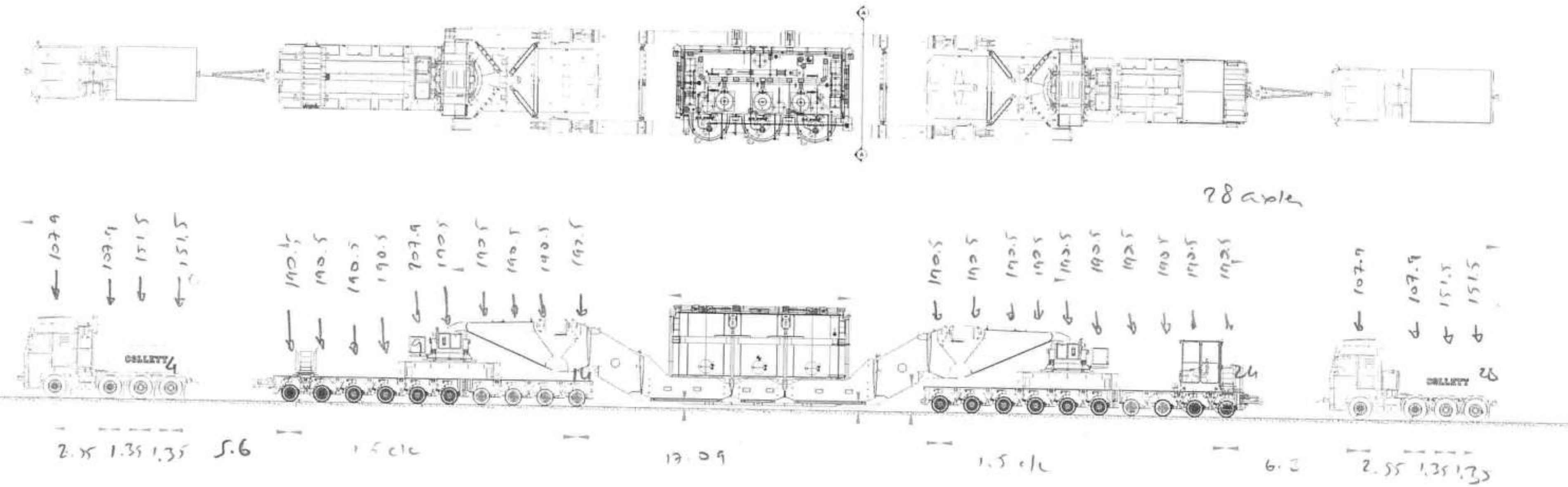
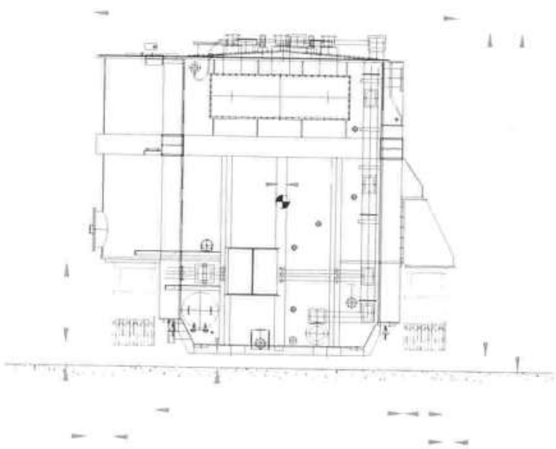
Paper Size:	Scale:	Project No:	Drawing No:	Sheet No:
A3	1:50			1 of 1

PLAN & SIDE ELEVATION. SCALE 1:200



SECTION A-A. SCALE 1:75



Preliminary

1.	THIS DRAWING IS PRELIMINARY AND RELEASED FOR INFORMATION ONLY.
2.	ALL DIMENSIONS ARE IN MILLIMETRES (mm) UNLESS OTHERWISE STATED.
3.	ALL WEIGHTS ARE IN METRIC TONNES (t) UNLESS OTHERWISE STATED.
4.	THE CLIENT IS RESPONSIBLE FOR THE PREPARATION OF THE TRANSPORT AREAS TO ENSURE THAT IT IS CAPABLE OF ACCOMMODATING THE LOADS GENERATED BY THE TRAILERS DURING ALL TRANSPORT / LOADING AND UNLOADING OPERATIONS. GROUND TO BE SUITABLY COMPACTED AND LEVELLED FOR A SAFE AND CONVENIENT TRANSPORT OPERATION.
5.	THE CLIENT IS RESPONSIBLE FOR THE STRUCTURAL INTEGRITY OF THE LOAD TRANSPORTED.
6.	THE CLIENT IS TO IDENTIFY AND CONFIRM THE SUITABILITY OF THE SUPPORT POINTS ON THE LOAD TO BE UTILISED DURING TRANSPORT.
7.	SECURE CARGO ONTO THE TRAILER USING LASHING MATERIAL TO PREVENT SLIDING AND/OR TIPPING OF THE LOAD. ALL STRAPS AND CHAINS TO BE TIGHTENED WITH RATCHET BINDERS. ANTI SLIP RUBBER MATTING TO BE USED BETWEEN THE TRAILER AND THE BASE OF THE LOAD INCLUDING ALL STEEL CONTACT AREAS TO PROMOTE FRICTION.
8.	ALL EQUIPMENT IS SUPPLIED IN ACCORDANCE WITH COLLETT & SONS LIMITED TERMS AND CONDITIONS, AND THE RELEVANT R.H.A. 2009 TERMS AND CONDITIONS.
9.	WITHOUT AUTHORISED SIGNATURES THIS DOCUMENT IS UNCONTROLLED, NOT BINDING AND FOR INDICATIVE PURPOSES ONLY.

Weights Table

Type	Description	Weight
Type of Trailer	10 Axle Girder Set 10 Axle	134.500 t
Type of Load	Transformer	178.000 t
	Total loaded weight excluding tractor units	312.500 t
	Load per axle line on trailer	15.625 t
	Load per axle	7.813 t
	Load per wheel	1.953 t

Abnormal Load Classification: **Special Order (BE16)**

Rev:	Drawn by:	Date:	Checked by:	Date:
01	JW	13/12/2018	EC	13/12/2018

Description: Weight amended.

Client: **COLLETT HEAVY LIFT**

Project: **Taunton Substation**

Title: **Transport Arrangement**

COLLETT — EXPERTS IN MOTION

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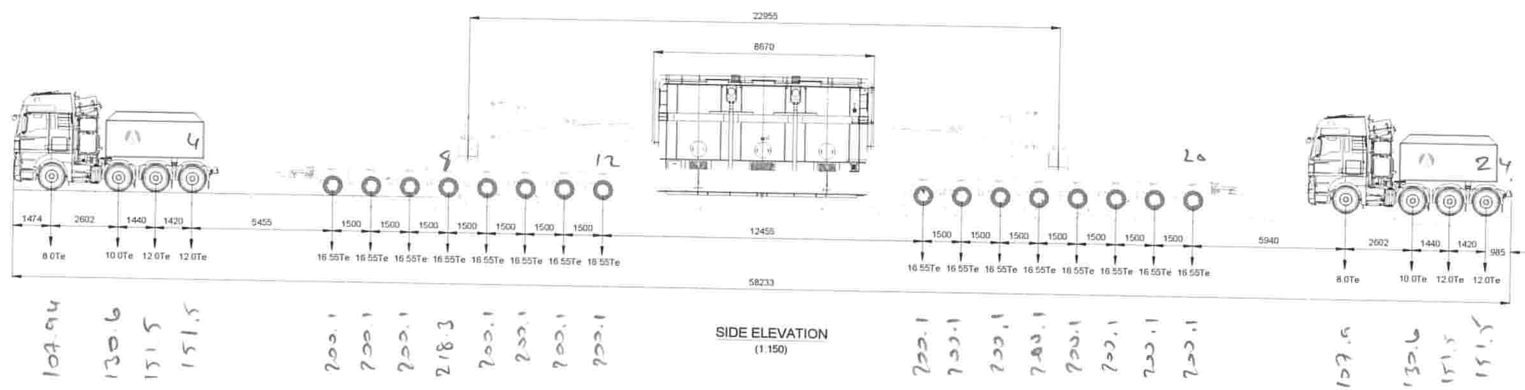
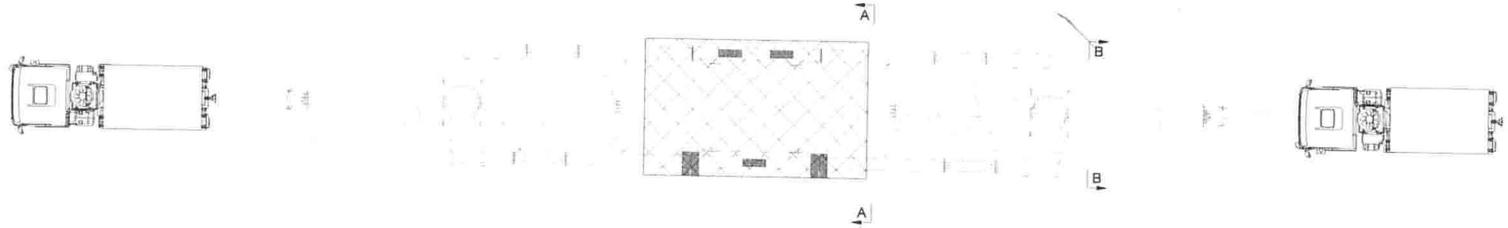
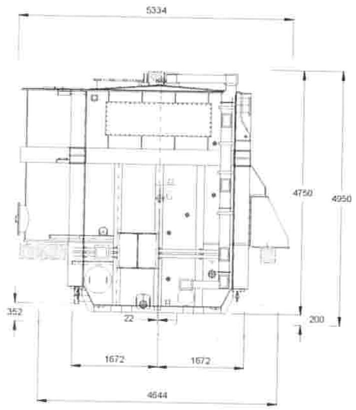
Paper Size:	Scale:	Project No:	Drawing No:	Sheet No:
A3	As Noted	322727	COL-D-322727-1-1	1 of 1



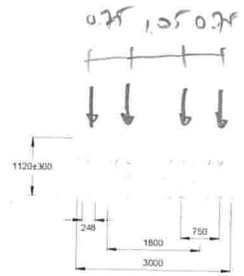
SIDE ELEVATION
(1:150)



PLAN VIEW
(1:150)



SECTION A-A
(1:100)



SECTION B-B
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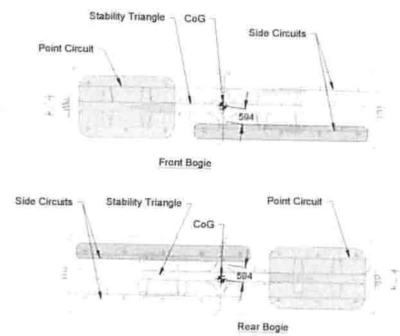
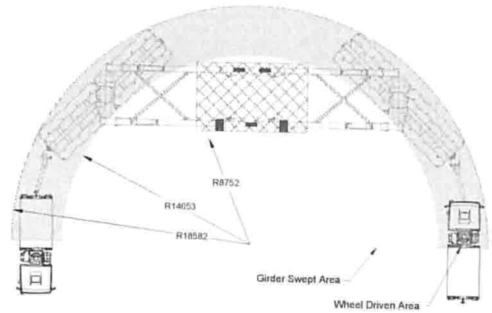


TRAILER STABILITY
(1:200)



TURNING RADII
(1:400)

DRAWING NOTES:
1. All dimensions are in mm unless otherwise stated
2. All weights are in metric tonnes unless otherwise stated
3. All details are provisional and are subject to confirmation
4. Tractor unit(s) dimensions and axle spacings may vary depending on the type of tractor unit(s) used.

TECHNICAL NOTES:

Load Table	
Applied Load Weight (Te)	178.00
Trailer Tare Weight (Te)	86.80
Auxiliary Steel Work (Te)	0.00
Trailer Gross Weight (Te)	264.80
Load per Bogie (Te)	132.40
Load per Axle (Te)	16.55
Block Ground Loading (Te/m²)	3.68

Rev.	Date	Drawn	Ammendments
A	06/12/2018	EDA	Weight Change
B	17/08/2018	EDA	Issued for comment

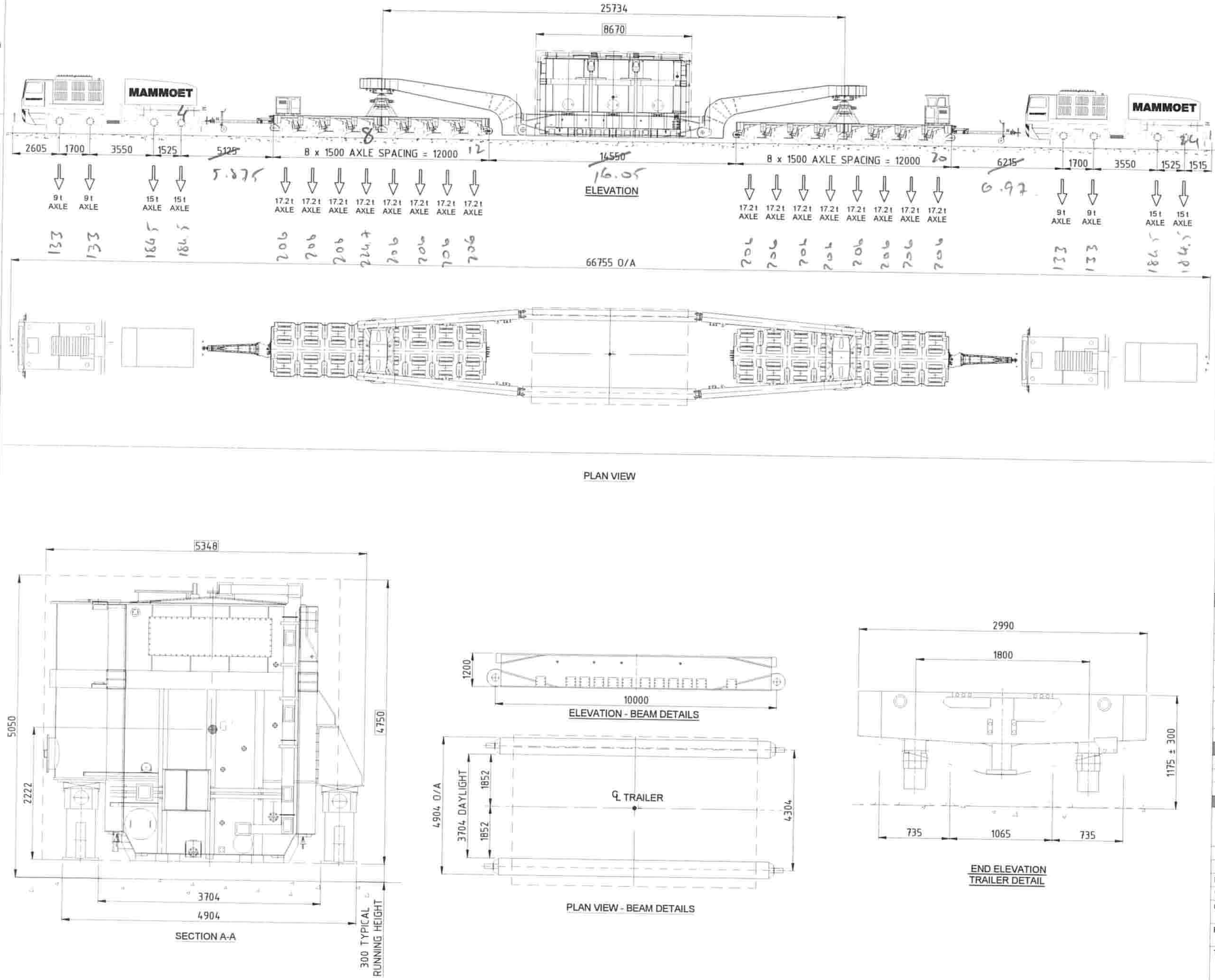
Revisions

Allelys Group
The Slough, Studley, Warwickshire, B80 7EN
Tel: +44 (0) 1527 852 408
e-mail: enquiries@allelys.co.uk

Client	Wynns
Project	Taunton
Title	178 Te Transformer 16 Axle Girder Frame Transport Arrangement
Scale (A3)	1:100, 1:200, 1:400
Drawn	EDA
Checked	MJC
Dwg. No	WWPN-18-049-00
Sheet	1 of 1
Revision	A

DO NOT SCALE

IF IN DOUBT ASK



TRAILER SPECIFICATION

AL50 (16 AXLE) 10m BEAM

all weights in t (metric tonnes)	Total
NUMBER OF AXLE LINES	16
NUMBER OF FILES	2
LOAD DETAILS	
PAY LOAD	178
TRANSPORTER WEIGHT	97.2
ENGINE WEIGHT	-
AUXILIARY STEEL WEIGHT	0.0
TOTAL LOAD	275.2
LOAD PER AXLE LINE / TRAILER	17.2
LOAD PER FILE	8.6
LOAD PER WHEEL	2.1
GROUND BEARING PRESSURE t/m²	3.8

TECHNICAL NOTES:-

- SHIPPING DIMENSIONS: 8.67 x 5.348 x 4.75mm (L x W x H) @ 178te.
- ORIENTATION TO BE CONFIRMED BY CLIENT/HYUNDAI.
- **REDUCIBLE HEIGHT OF 4850mm**

GENERAL NOTES	
1	CLIENT IS RESPONSIBLE FOR THE LEVELLING, COMPACTING AND CLEARING OF THE TRANSPORT AREA TO ALLOW TRAILER OPERATIONS.
2	CLIENT IS RESPONSIBLE FOR THE STRUCTURAL INTEGRITY OF THE LOAD TO BE TRANSPORTED.
3	CLIENT TO CONFIRM SUITABILITY OF SUPPORT POINTS DESIGNATED IN THIS DRAWING.
4	SECURE CARGO ONTO TRAILER USING LASHING MATERIAL.
5	ANTI SLIP MATERIAL TO BE USED BETWEEN ALL STEEL-STEEL CONTACT AREAS TO INCREASE FRICTION.
6	SUPERVISOR CAN MAKE MINOR FIELD ADJUSTMENTS TO PLAN

REFERENCE DRAWINGS

REF	DRAWING NUMBER	REV
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DRAWING STATUS

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REV	DESCRIPTION	DATE	DRAWN	CHECKED
00	First Issue	31/01/2022	PCox	ACam

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CLIENT:

PROJECT: CELLARHEAD

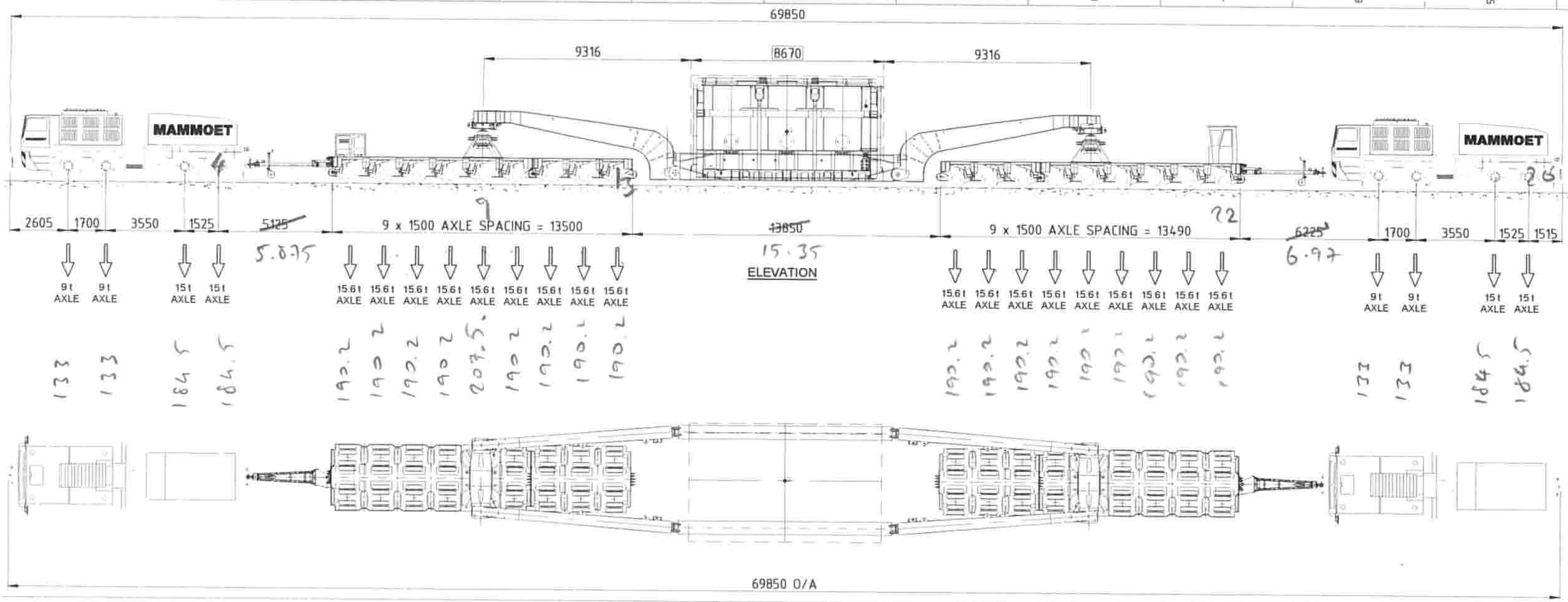
TITLE: 178Te TRANSFORMER
AL50 16 AXLE TRANSPORT ARRANGEMENT
HYUNDAI 400/132KV 240MVA

MAMMOET

SCALE: N.T.S. | SIZE:

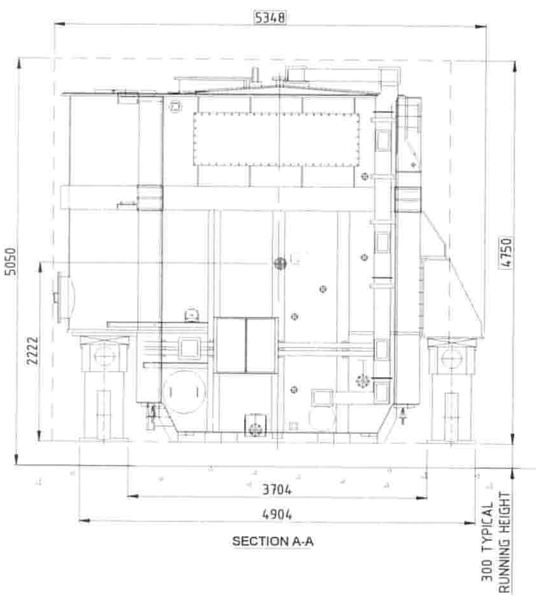
SAP No: 7000257402

DRAWING NUMBER: PROJECT No - SUB - DOC -D- PART T01 - SHT 1/1 - REV 00

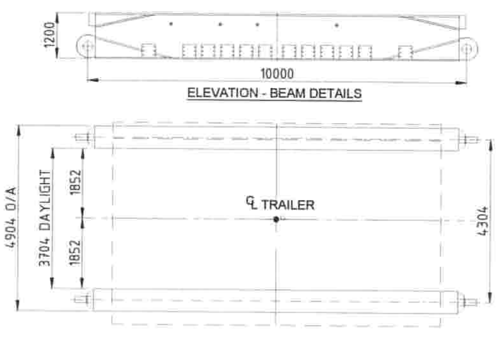


ELEVATION

PLAN VIEW

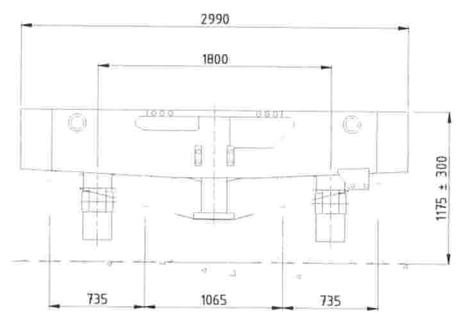


SECTION A-A



ELEVATION - BEAM DETAILS

PLAN VIEW - BEAM DETAILS



END ELEVATION TRAILER DETAIL

TRAILER SPECIFICATION	
AL50 (18 AXLE) 10m BEAM	
all weights in t (metric tonnes)	Total
NUMBER OF AXLE LINES	18
NUMBER OF FILES	2
LOAD DETAILS	
PAY LOAD	178
TRANSPORTER WEIGHT	103.2
ENGINE WEIGHT	-
AUXILIARY STEEL WEIGHT	0.0
TOTAL LOAD	281.2
LOAD PER AXLE LINE / TRAILER	15.6
LOAD PER FILE	7.8
LOAD PER WHEEL	1.9
GROUND BEARING PRESSURE t/m²	3.48

TECHNICAL NOTES:-

- SHIPPING DIMENSIONS: 8.67 x 5.348 x 4.75mm (L x W x H) @ 178te.
- ORIENTATION TO BE CONFIRMED BY CLIENT/HYUNDAI.
- **REDUCIBLE HEIGHT OF 4850mm**

GENERAL NOTES

1. CLIENT IS RESPONSIBLE FOR THE LEVELLING, COMPACTING AND CLEARING OF THE TRANSPORT AREA TO ALLOW TRAILER OPERATIONS.
2. CLIENT IS RESPONSIBLE FOR THE STRUCTURAL INTEGRITY OF THE LOAD TO BE TRANSPORTED.
3. CLIENT TO CONFIRM SUITABILITY OF SUPPORT POINTS DESIGNATED IN THIS DRAWING.
4. SECURE CARGO ONTO TRAILER USING LASHING MATERIAL.
5. ANTI SLIP MATERIAL TO BE USED BETWEEN ALL STEEL-STEEL CONTACT AREAS TO INCREASE FRICTION.
6. SUPERVISOR CAN MAKE MINOR FIELD ADJUSTMENTS TO PLAN

REFERENCE DRAWINGS

REF	DRAWING NUMBER	REV
00		

DRAWING STATUS

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REV	DESCRIPTION	DATE	DRAWN	CHECKED
00	First Issue	31/01/2022	PCox	ACam

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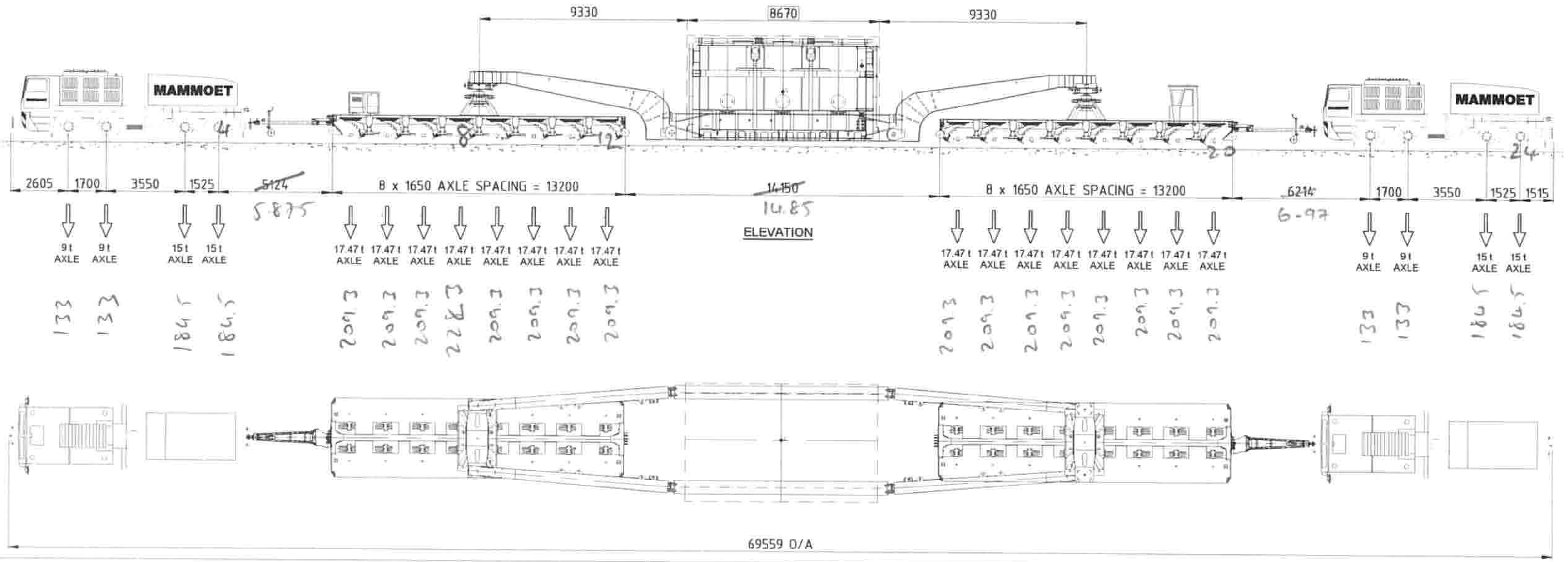
CLIENT:

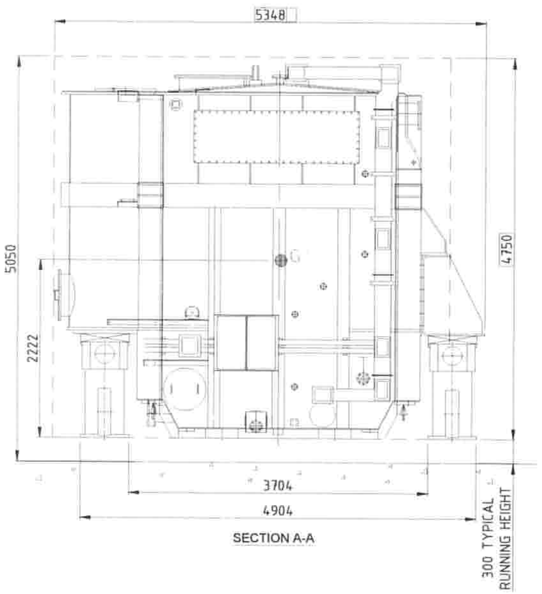
PROJECT: CELLARHEAD

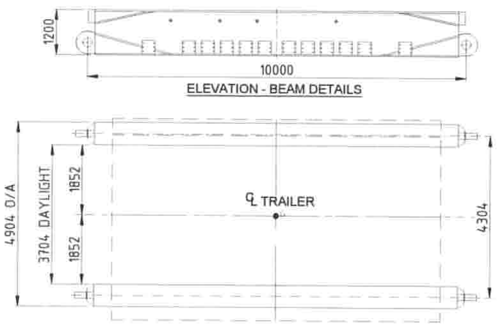
TITLE: 178Te TRANSFORMER
AL50 18 AXLE TRANSPORT ARRANGEMENT
HYUNDAI 400/132KV 240MVA

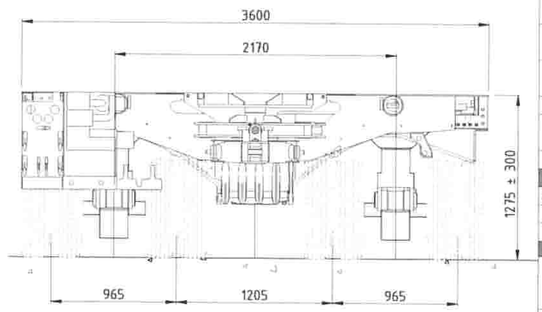
MAMMOET

SCALE: N.T.S.	SIZE:	PROJECT No	SUB	DOC	PART	SHT	REV
SAP No: 7000257399		-	-	D	T01	1/1	00









TRAILER SPECIFICATION	
AL50 (16 WIDENING AXLE) 10m BEAM	
all weights in t (metric tonnes)	Total
NUMBER OF AXLE LINES	16
NUMBER OF FILES	2
LOAD DETAILS	
PAY LOAD	178
TRANSPORTER WEIGHT	101.6
ENGINE WEIGHT	-
AUXILIARY STEEL WEIGHT	0.0
TOTAL LOAD	279.6
LOAD PER AXLE LINE / TRAILER	17.46
LOAD PER FILE	8.73
LOAD PER WHEEL	2.18
GROUND BEARING PRESSURE t/m²	2.94

TECHNICAL NOTES:-

- SHIPPING DIMENSIONS: 8.67 x 5.348 x 4.75mm (L x W x H) @ 178te.
- ORIENTATION TO BE CONFIRMED BY CLIENT/HYUNDAI.
- **REDUCIBLE HEIGHT OF 4850mm**

GENERAL NOTES

1	CLIENT IS RESPONSIBLE FOR THE LEVELLING, COMPACTING AND CLEARING OF THE TRANSPORT AREA TO ALLOW TRAILER OPERATIONS.
2	CLIENT IS RESPONSIBLE FOR THE STRUCTURAL INTEGRITY OF THE LOAD TO BE TRANSPORTED.
3	CLIENT TO CONFIRM SUITABILITY OF SUPPORT POINTS DESIGNATED IN THIS DRAWING.
4	SECURE CARGO ONTO TRAILER USING LASHING MATERIAL.
5	ANTI SLIP MATERIAL TO BE USED BETWEEN ALL STEEL-STEEL CONTACT AREAS TO INCREASE FRICTION.
6	SUPERVISOR CAN MAKE MINOR FIELD ADJUSTMENTS TO PLAN

REFERENCE DRAWINGS

REF	DRAWING NUMBER	REV
00		

DRAWING STATUS

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REV	DESCRIPTION:	DATE:	DRAWN:	CHECKED:
00	First Issue	08/03/2022	PCox	ACam

CLIENT:

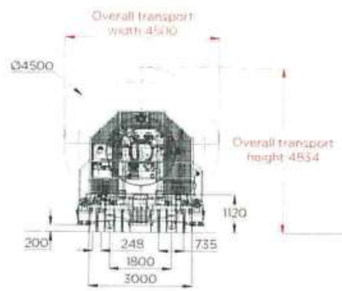
PROJECT: CELLARHEAD

TITLE: 178Te TRANSFORMER
AL50 16 WIDENING AXLE TRANSPORT ARRANGEMENT
HYUNDAI 400/132KV 240MVA

MAMMOET

SCALE: N.T.S. | SIZE: | DRAWING NUMBER
SAP No: 7000257398 | PROJECT No | SUB - | DOC -D- | PART T01 | SHT - 1/1 | REV - 00

23



Profile view

OF DAF

Elevation view - 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum

6.4t = 62.8kW x 1.1 x 1.29 = 89.1 kW

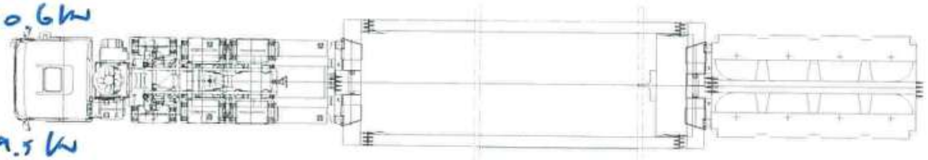
10t = 98.1 kW x 1.1 x 1.21 = 130.6kW

16.5t = 161.9kW x 1.1 x 1.12 = 199.5 kW

" = " x 1.2 x " = 217.6kW.

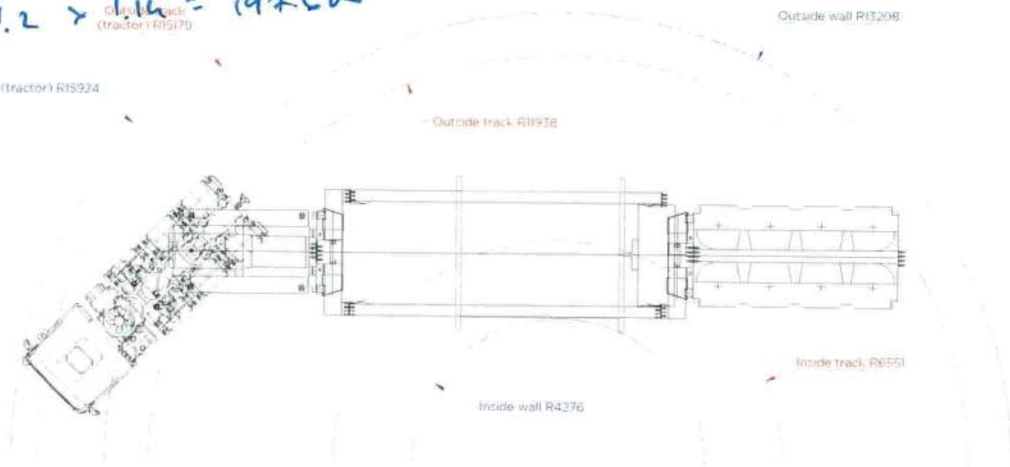
14.72t = 144.4 x 1.1 x 1.14 = 181.1 kW

" = " x 1.2 x 1.14 = 197.6kW



Plan view - 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum

STLO - cat 3



Minimum turning radii information
4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum

Load table

4 axle modular reeling trailer	
Self weight of cable drum	60.0 te
Self weight of trailer	33.3 te
Self weight of tractor	15.0 te
Total combined weight	108.3 te
Load per axle line (trailer)	14.72 te
Load per axle	7.36 te
Load per wheel (4 per axle)	1.84 te
Overall ground bearing pressure	3.27 te/m²

Tractor (15 te)	
Front axle	6.4 te
Second steer	10.0 te
Rear axle	16.5 te
Rear axle	16.5 te

Notes
[1] The figures shown above are representative of the transport configuration portrayed. However as tractor and trailer arrangements vary then the loads and dimensions indicated should be treated as probable values

[2] Actual dimensions, including axle spacing and mean running height, may vary slightly depending on manufacturer of trailer deployed.

[3] All linear measures in millimetres unless stated otherwise

(6)

Rev	Date	Amendments
1		
0	24 05 21	Issued for comment

Revisions

Prepared by
WYNNS Independent Transportation Engineers
Shaftesbury House, 2 High Street, Eccleshall, Stafford, ST21 6BZ
Tel (01785) 851411

Independent Transportation Engineers

Client
nationalgrid
National Grid
Hams Lane
Coleshill
West Midlands
B46 1AW

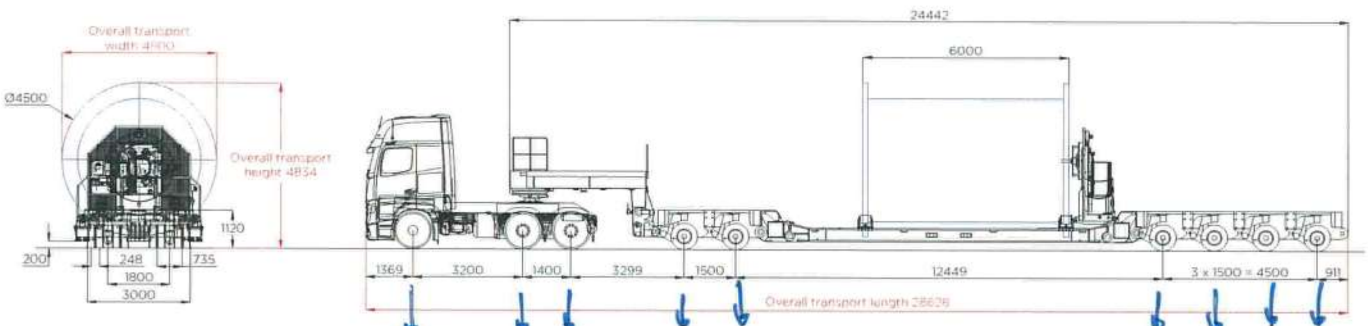
Project
Bramford to Twinstead

Title
Indicative transport configuration
Indicative 60.0 te cable drum carried on 4 axle modular reeling trailer showing minimum turning radii

Drawing status
Final report

Scale (A3)	Drawn By	Checked By
1:150	SJW	ARP
Dwg. no	**Sheet**	**Rev**
21-1030 TC01	1 of 1	0

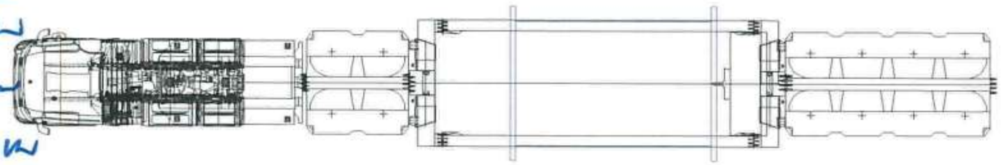
P:\Clients\Existing Clients\National Grid Company\Proposed New sites investigations\21-1030 Bramford to Twinstead\Cable drums 2021\21-1030 TC01 Bramford to Twinstead cable drum 4 axle spooling trailer transport configuration R0.dwg



Profile view

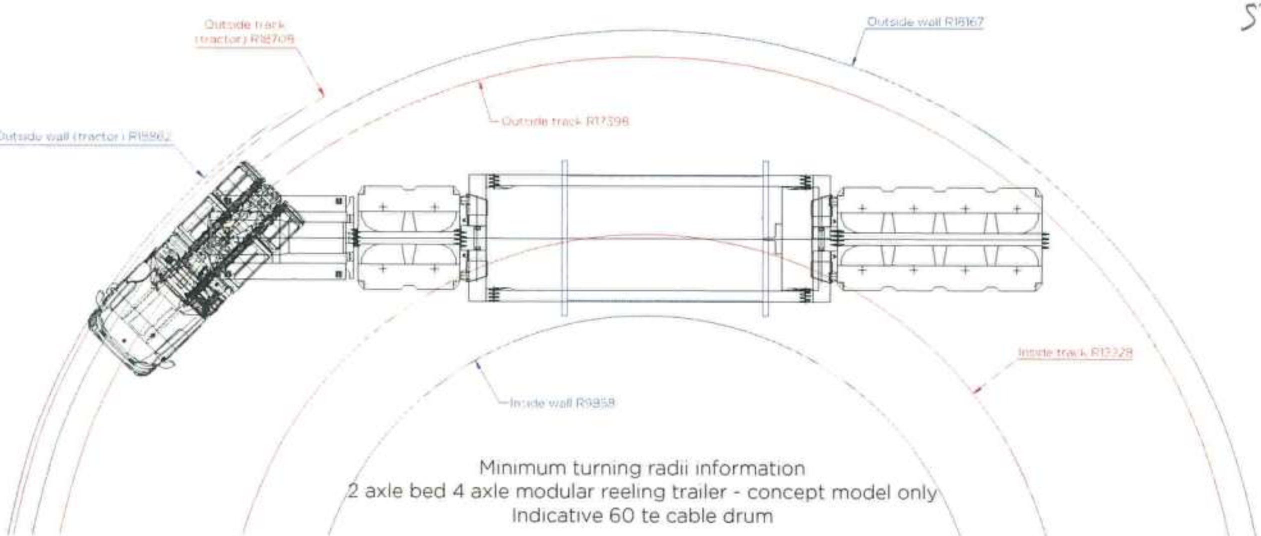
Elevation view - 2 axle bed 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum

OF DAF
8.1t = 79.46kN x1.1 x 1.25 = 109.3 kN
12.7t = 124.6kN x1.1 x 1.16 = 159 kN
14.12t = 138.5 kN x1.1 x 1.15 = 175.2kN
" = " x1.2 x 1.15 = 191.13kN



Plan view - 2 axle bed 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum

STGO cat 3



Minimum turning radii information
2 axle bed 4 axle modular reeling trailer - concept model only
Indicative 60 te cable drum

Load table	
4 axle modular reeling trailer	
Self weight of cable drum	60.0 te
Self weight of trailer	39.6 te
Self weight of tractor	12.0 te
Total combined weight	111.6 te
Max. load per axle line (trailer)	14.12 te
Load per axle	7.06 te
Load per wheel (4 per axle)	1.77 te
Max. overall ground bearing pressure (trailer)	4.77 te/m²
Tractor (12 te)	
Front steer	8.1 te
Rear axle	12.7 te
Rear axle	12.7 te

Notes.

[1] The figures shown above are representative of the transport configuration portrayed. However, as tractor and trailer arrangements vary then the loads and dimensions indicated should be treated as probable values

[2] Actual dimensions, including axle spacing and mean running height, may vary slightly depending on manufacturer of trailer deployed

[3] All linear measures in millimetres unless stated otherwise

[4] Minimum turning radii based upon maximum steering angle of 45 degrees. Some trailers operate to a maximum steering angle of 60 degrees, which will improve negotiability

(7)

Rev	Date	Amendments
1		
0	17.06.22	Issued for comment

Revisions

Prepared by:

WYNNS Independent Transportation Engineers

Shaftesbury House, 3 High Street, Eccleshall, Stafford, ST21 6BZ
Tel: (01785) 850411

Client: nationalgrid
National Grid, Hams Hall, Coleshill, West Midlands, B46 1AW

Project: **Bramford to Twinstead**

Title: **Indicative transport configuration**
Indicative 60.0 te cable drum carried on 2 axle bed 4 axle modular reeling trailer showing minimum turning radii

Drawing status: Final report

Scale (A3)	Drawn By	Checked By
1:150	SJW	---
Dwg. no	**Sheet**	**Rev**
21-1030 TC07	1 of 1	0

25

2405 - Town Bridge

ROBOT AIL Results for comparison and identification of most onerous vehicle and position on carriageway
File - 2405 - TownBridge - Rev1A 050722
* AIL Loads include OF and DAF only

Loadcase			Max Sag Moment		Max Shear	
Number	Lane	AIL	M (kNm)	Front Axle Position (m)	V (kN)	Front Axle Position (m)
10	Lane 1	Collet 20	170.85	24	304.69	23
11	Lane 2	Collet 20	139.04	22	280.01	26
12	Lane 3	Collet 20	185.38	22	267.25	19
20	Lane 1	Allelys 16	174.36	33	335.35	34
21	Lane 2	Allelys 16	147.61	34	281.12	34
22	Lane 3	Allelys 16	190.35	31	266.85	30
30	Lane 1	ALE AL50-16	186.37	27	345.62	29
31	Lane 2	ALE AL50-16	158.92	27	282.79	31
32	Lane 3	ALE AL50-16	191.55	27 ~~25~~	272.12	24
40	Lane 1	ALE AL50-18	190.2	26 ~~27~~	297.92	30
41	Lane 2	ALE AL50-18	154.35	25	290.09	29
42	Lane 3	ALE AL50-18	178.42	26	231.5	23
50	Lane 1	ALE AL50-16 W	175.45	29	241.17	30
51	Lane 2	ALE AL50-16 W	171.41	27	329.01	27
52	Lane 3	ALE AL50-16 W	155.8	28	241.72	27
60	Lane 1	60t CD 4AM	151.37	71	236.21	73
61	Lane 2	60t CD 4AM	115.41	70	230.71	72
62	Lane 3	60t CD 4AM	155.93	69	134.88	71
70	Lane 1	60t CD 2AB&4AM	146.11	71	228.01	73
71	Lane 2	60t CD 2AB&4AM	111.39	70	222.7	72
72	Lane 3	60t CD 2AB&4AM	150.52	69	130.19	71
	Max lane 1		190.2		345.62	
	Max lane 2		171.41		329.01	
	Max lane 3		191.55		272.12	

The AIL Loads 'ALE AL50-16', 'ALE AL50-18' & 'ALE AL50-16W' produce the most onerous load effects on the structure. These vehicles will be taken further in the analysis and the effects of the other vehicles are considered to fall within those of these critical vehicles.

WALLACE STONE	**Project :** TOWNBRIDGE		
Calculation Sheet	**Job No. :** 2405	**Made By :**	ØD
Description:	**Date :** JULY 22	**Checked :**	
	Page No.: 27 **of**		

Output

All loadcases

(1) · Lane 1 - max Bending = ALE AL50-18 · @. load posit 27m

(2) lane 1 - max Shear · = ALE AL50-16 @ load positi 29m

(3) lane 2 - max Bendy = ALE AL50 - 16w @ load posn 27m

(4) lane 2 - max Shear = ALE AL50 - 16w @. load position 27m

(5) lane 3 - max Bendy = ALE AL50 - 16 @ load position 25m

(6) lane 3 - max Shear = ALE AL50 - 16 @ load position 24m

WALLACE STONE	Project :	TOWNBRIDGE		
Calculation Sheet	Job No. :	2405	Made By :	RS
Description:	Date :	JULY 22	Checked :	
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Output

Application of abnormal vehicle

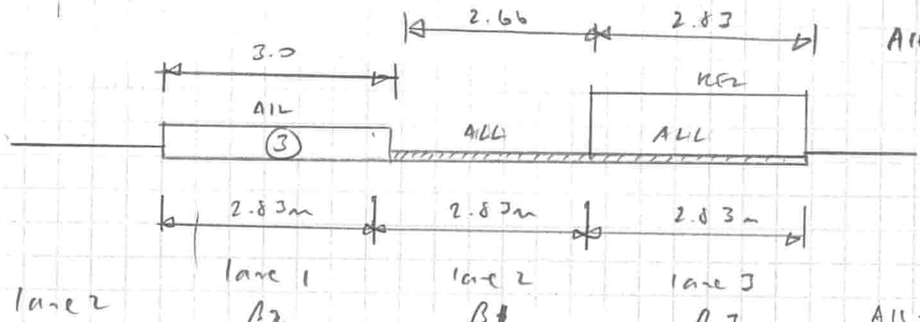
carriageway width C = 8.5 m   notional lane = C/n

table 5.18 of CS 454   n = 3   ∴ notional lane width = 8.5/3 = 2.83 m.

Due to curvature of road and vehicle size the vehicle will have a police escort to prevent other road users on the bridge. However, consider with and without associated HA loads. for completeness.

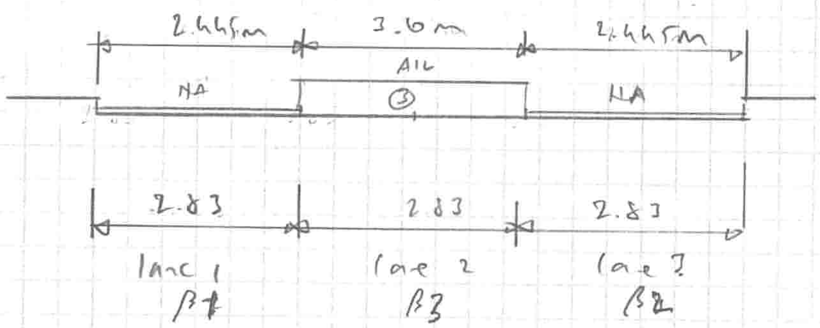
LOAD ARRANGEMENT FOR AIL's on lane 1, 2 & 3

(a) lane 1. (same for 3 but handed)



AIL = AL50 - 16 or AL50 - 18

(b) lane 2



AIL = ALE - AL50 - 16W width = 3.6m

Assessment live load in other lanes = HA (UDL + KEL) - ALL model 2 - cl. 5.17 CS454

$L = 8.57\,m$ $UDL = 230/L^{0.67}$ = 54.53 kN/m of notional lane

lane factor. $\beta_1 = 1.0$ $\beta_2 = 1.0$ $\beta_3 = 0.5$.

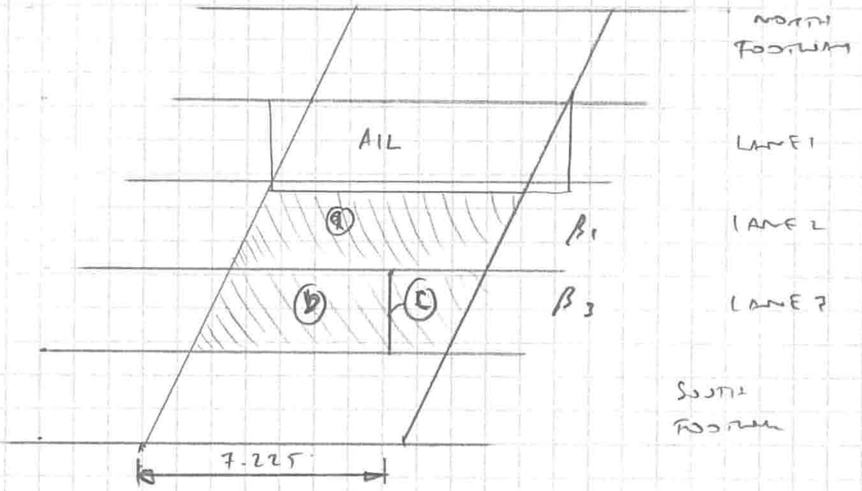
KEL = 82 kN

WALLACE STONE	Project :	TWINBRIDGE		
Calculation Sheet	Job No. :	2405	Made By :	RJ
Description:	Date :	JULY 22	Checked :	
	Page No.:	29 of		

Output

AIL Loading

(1) Lane 1 max Bending – ALE AL50-18

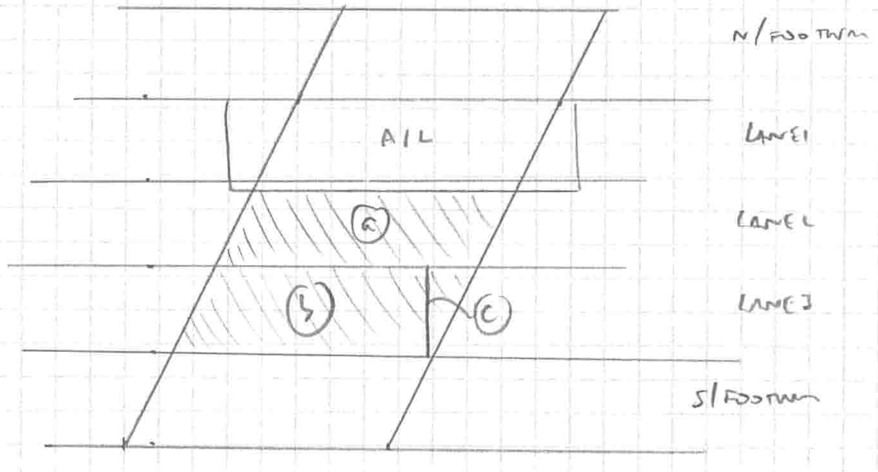


(a) = 54.53 / 2.66 x 1.0 = 20.5 kN/m^2

(b) = 54.53 / 2.83 x 0.5 = 9.63 kN/m^2

(c) = 82 / 2.83 x 0.5 = 14.49 kN/m

(2) Lane 1 max Shear – ALE AL50-16



(a), (b) and (c) same as (1)

WALLACE STONE	**Project :** TW Bridge		
Calculation Sheet	**Job No. :** 2405	**Made By :**	B
Description:	**Date :** July 22	**Checked :**	
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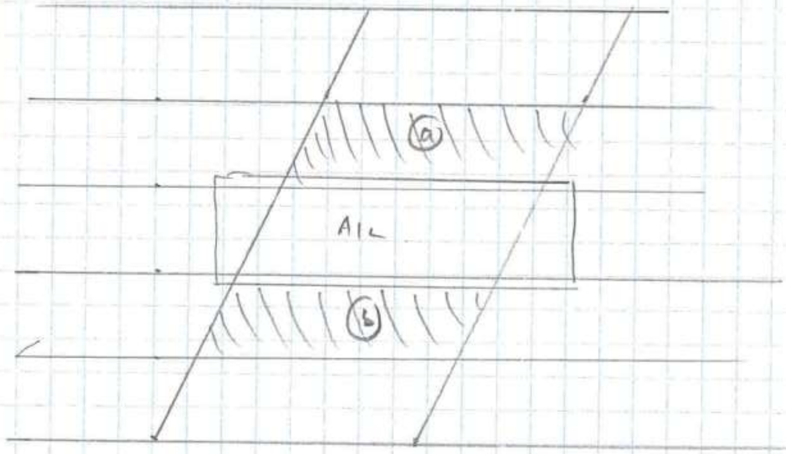
Output

AIL loading

(3) lane 2 max bending - ALE AL50-16W

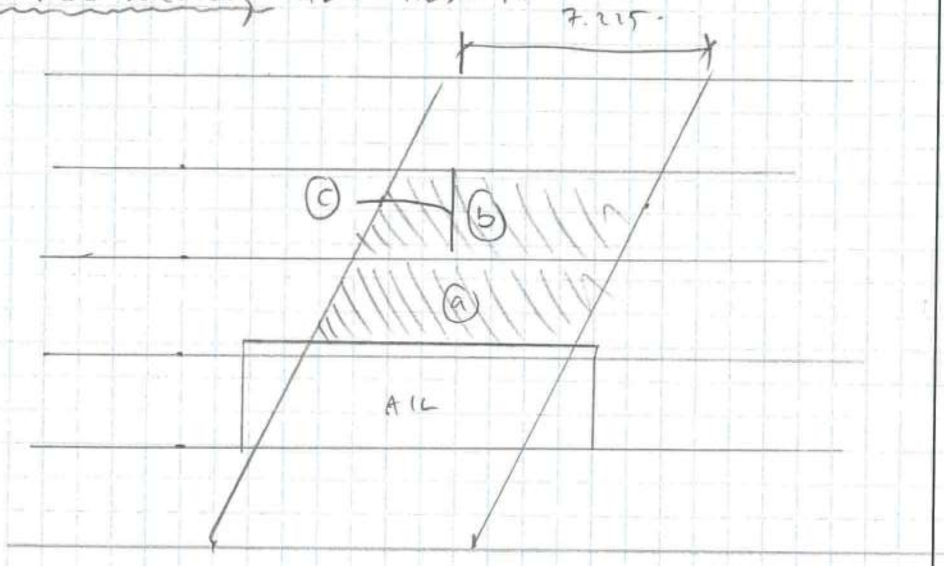


(a) : 54.53 / 2.445 × 1.0 = 22.3 kN/m²

(b) = 54.53 / 2.445 × 1.0 = 22.3 kN/m²

(4) lane 2 max shear - same as above.

(5) lane 3 max bending ALE-AL50-16



(a) (b) and (c) same as load scenario (1)

(6) lane 3 max shear - same as (5) except when placed near support

WALLACE STONE	Project : TOWNBRIDGE	
Calculation Sheet	Job No. : 2405	Made By : RD
Description:	Date : July 22	Checked :
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Output

Loading

Verification of loads applied in ROBOT model

(10) LL L1 Max Bending HA

(a) 20.5 kN/m² × 8.57 m × 2.66 m = 467.32 kN

(b) 9.63 kN/m² × 8.57 m × 2.83 m = 233.56 kN

(c) 14.49 kN/m × 2.83 m = 41.06 kN

741.94 kN — ROBOT 743.68 — 0.23% diff. ∴ ok

(11) LL L1 Max Shear HA

As above 741.94 kN — ROBOT 743.68 ∴ ok

(12) LL L2 Max Bending HA

22.3 kN/m² × 8.57 × 2.445 m × 2 No. = 934.5 kN — ROBOT 936.45 — 0.2% diff. ∴ ok

(13) LL L2 Max Shear HA

Same as above. 934.5 kN — ROBOT 936.45 kN ∴ ok

(14) LL L3 Max bending HA

Same as L1 Max Bending HA ∴ 741.94 kN — ROBOT 743.51 kN ∴ 0.21% diff.

(15) LL L3 Max Shear HA

Same as above ∴ ok

WALLACE STONE	Project :	TOWN BRIDGE		
Calculation Sheet	Job No. :	7405	Made By :	RD
Description:	Date :	July 22	Checked :	
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Output

Load Combinations

201. Lane 1 Max Bending

		γ_{f1}	γ_{f3}	
1.	SW	× 1.15	× 1.1	= 1.265
2.	Infill concrete	1.2	× 1.1	= 1.32
3	Surfacing	1.75	× 1.1	= 1.925
4.	Parapet	1.2	× 1.1	= 1.32
10.	LL L1 Max Bending HA	1.3	× 1.1	= 1.43
111	Lane 1 max bending ALL	1.1	× 1.1	= 1.21

202 Lane 1 Max Shear

		γ_{f1}	γ_{f3}	
1.	SW	× 1.15	× 1.1	= 1.265
2.	Infill concrete	× 1.2	× 1.1	= 1.32
3	Surfacing	× 1.75	× 1.1	= 1.925
4.	Parapet	× 1.2	× 1.1	= 1.32
11.	LL L1 Max Shear HA	1.3	× 1.1	= 1.43
112.	lane 1 Max Shear ALL	1.1	× 1.1	= 1.21

203 lane 2 Max Bending

		γ_{f1}	γ_{f3}	
1	SW	1.15	× 1.1	= 1.265
2	Infill concrete.	1.2	× 1.1	= 1.32
3	Surfacing	1.75	× 1.1	= 1.925
4	Parapet	1.2	× 1.1	= 1.32
12	LL L2 Max bending HA	1.3	× 1.1	= 1.43
113	Lane 2 Max bending ALL	1.1	× 1.1	= 1.21

WALLACE STONE	Project : TUNNBRIDGE		
Calculation Sheet	Job No. : 2405	Made By :	RS
Description:	Date : JULY 22	Checked :	
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Output

Load Combinations

204 Lane 2 Max. Shear

		γf1		γf3	
1	SW	1.15	×	1.1	= 1.265
2	Infill concrete	1.2	×	1.1	= 1.32
3	Surfacing	1.75	×	1.1	= 1.925
4	Parapet	1.2	×	1.1	= 1.32
13	LL L2 Max shear HA	1.3	×	1.1	= 1.43
114	Lane 2 Max Shear ALL	1.1	×	1.1	= 1.21

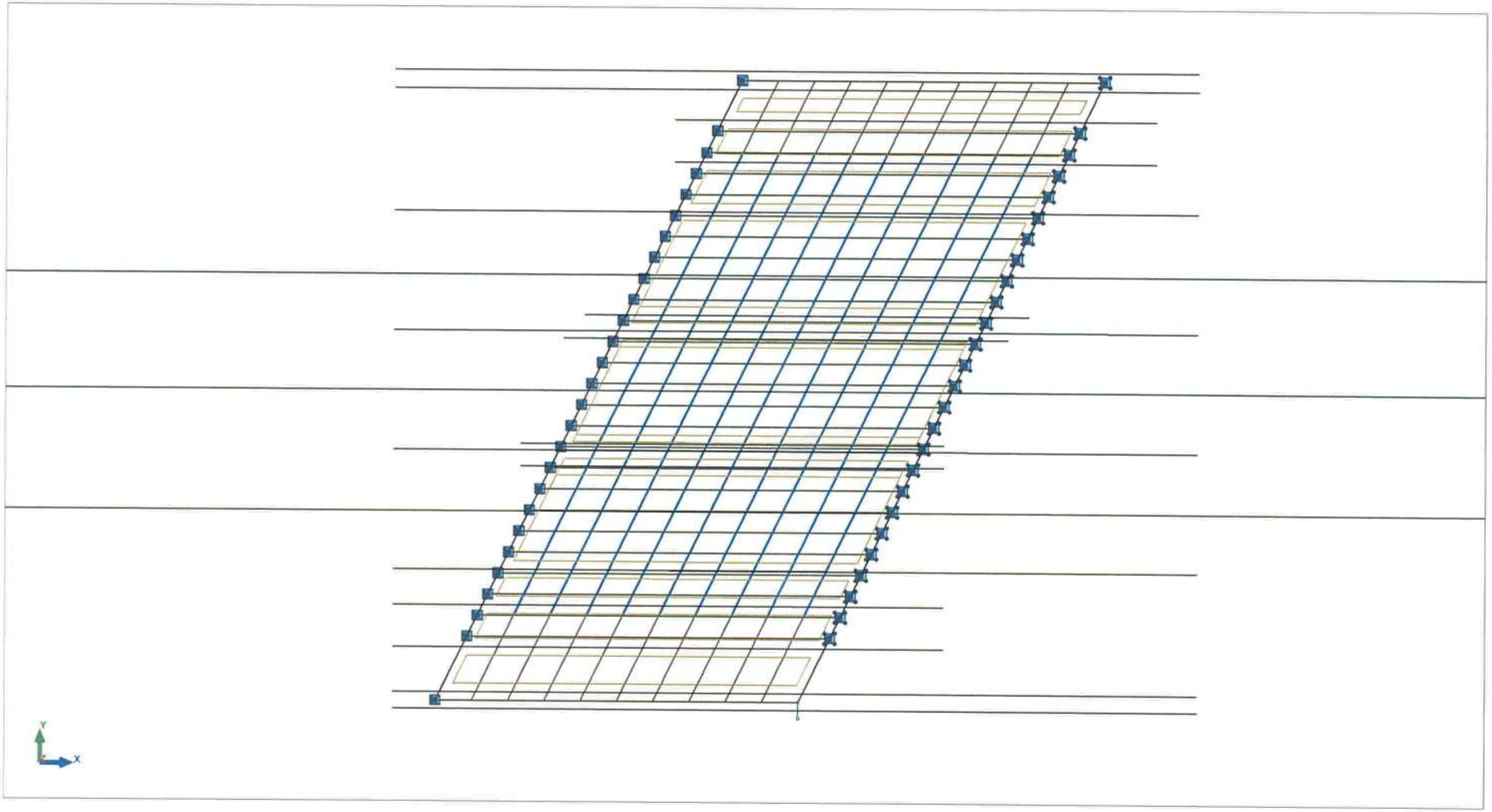
205 Lane 3 Max bending

		γf1		γf3	
1	SW	1.15	×	1.1	= 1.265
2	Infill concrete	1.2	×	1.1	= 1.32
3	Surfacing	1.75	×	1.1	= 1.925
4	Parapet	1.2	×	1.1	= 1.32
14	LL L3 Max bending HA	1.3	×	1.1	= 1.43
115	Lane 3 Max bending ALL	1.1	×	1.1	= 1.21

206 Lane 3 Max Shear

		γf1	γf3	
1	SW	1.15	1.1	= 1.265
2	Infill concrete	1.2	1.1	= 1.32
3	Surfacing	1.75	1.1	= 1.925
4	Parapet	1.2	1.1	= 1.32
15	LL L3 Max shear HA	1.3	1.1	= 1.43
116	Lane 3 Max shear ALL	1.1	1.1	= 1.21

Plan View - General



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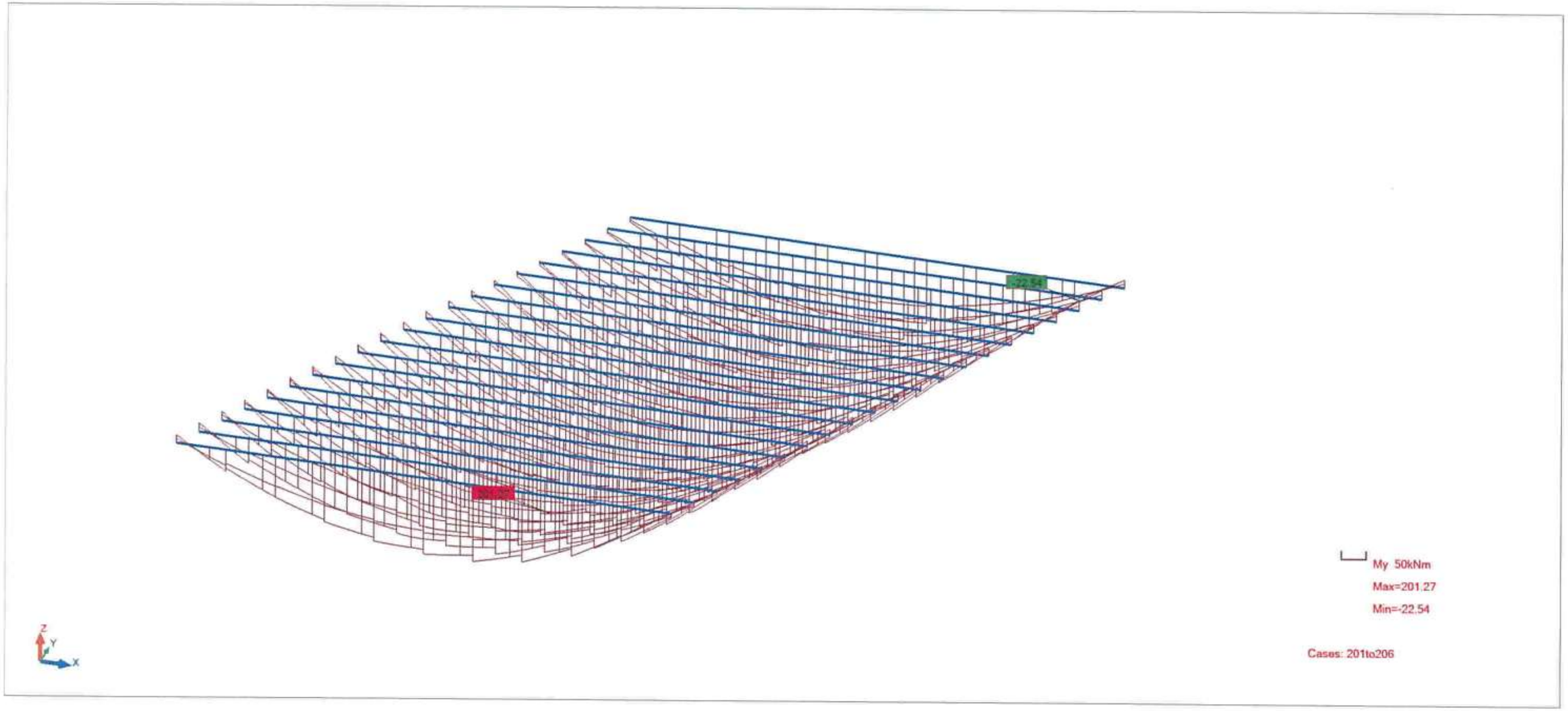
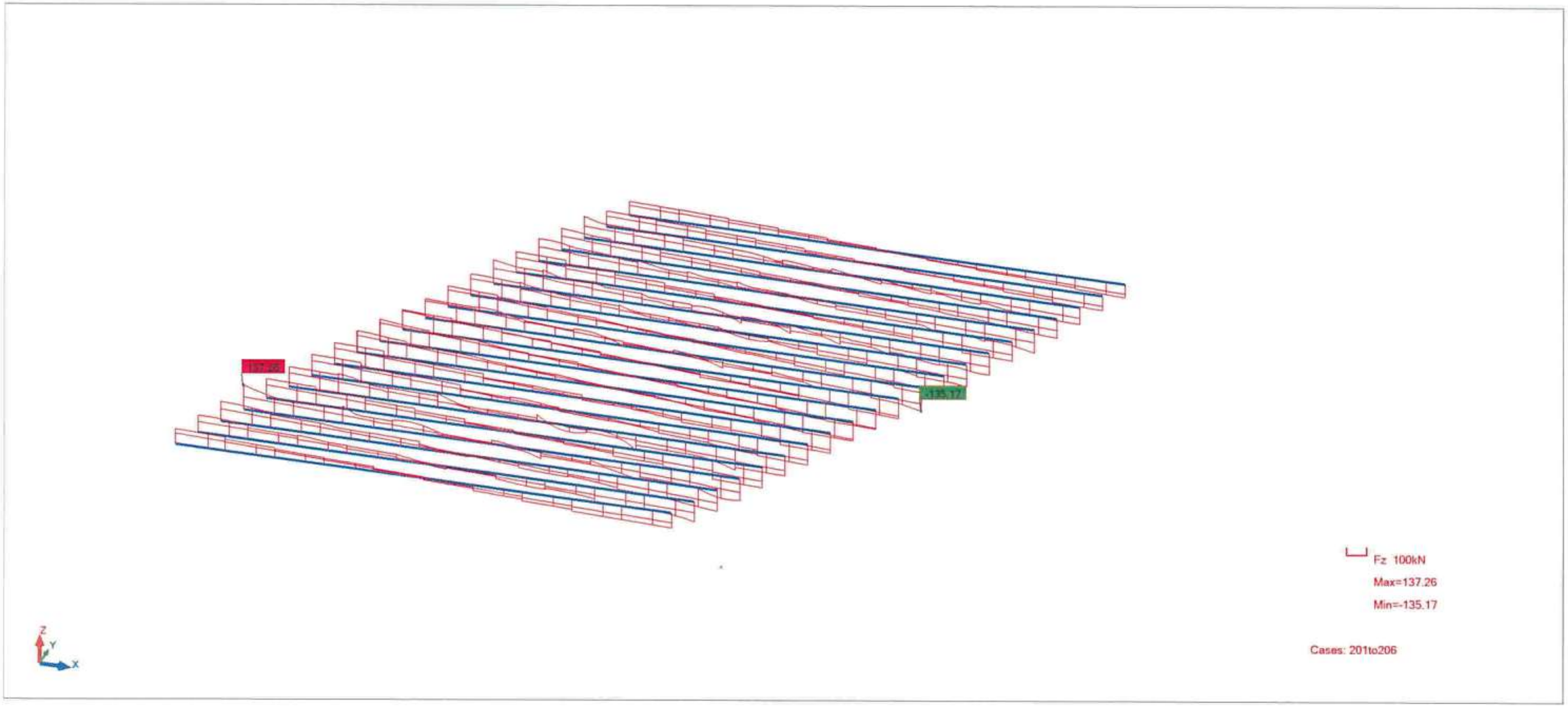
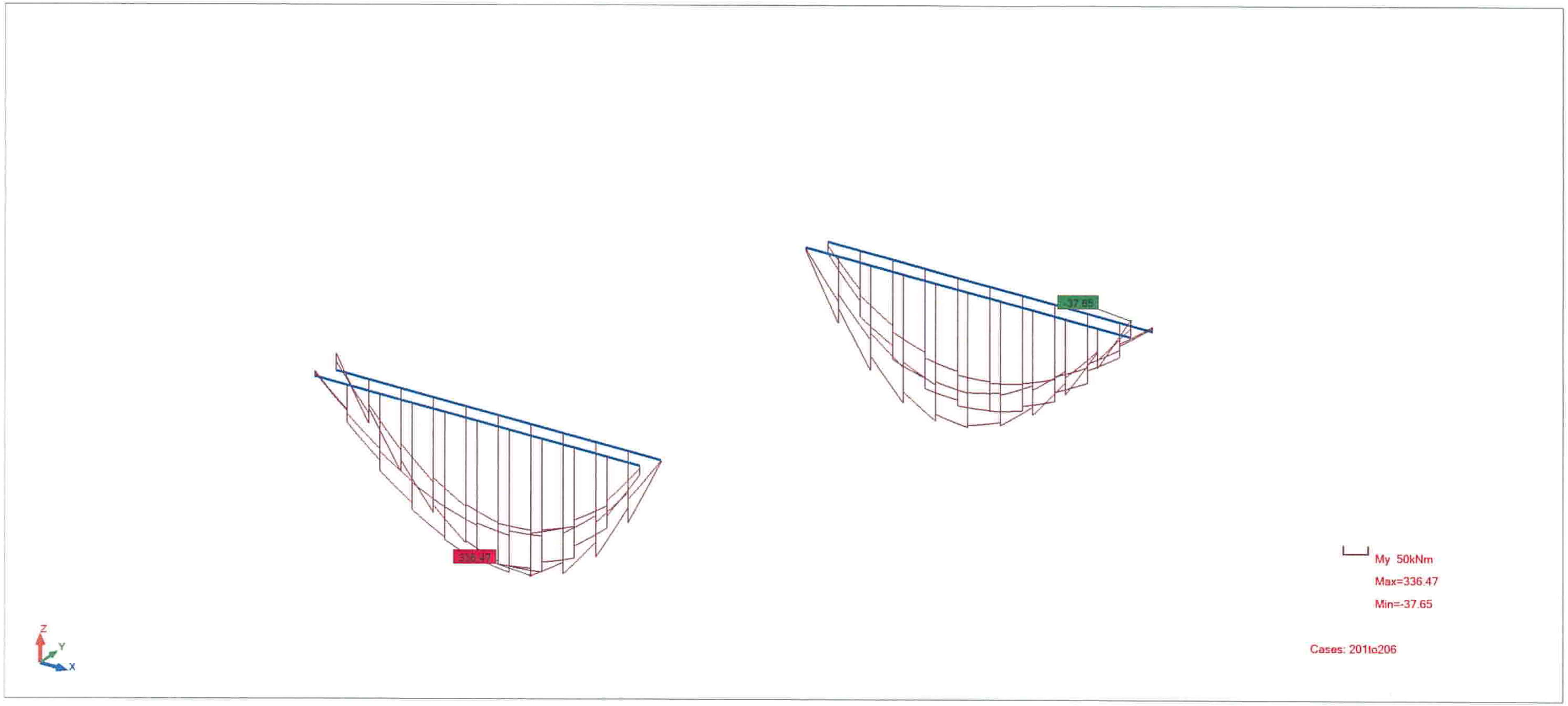
T1 Beam Max Bending Envelope



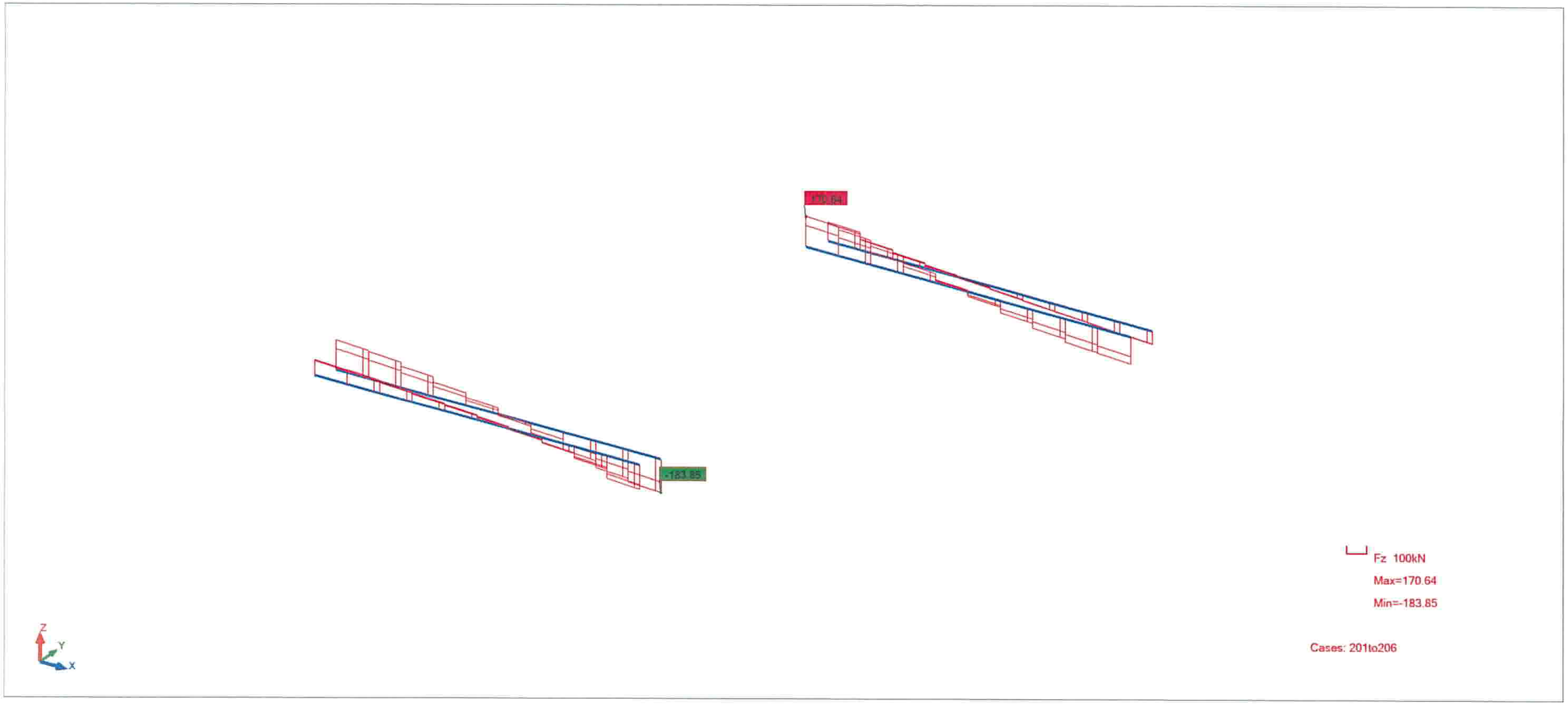
T1 Beams Max Shear Envelope



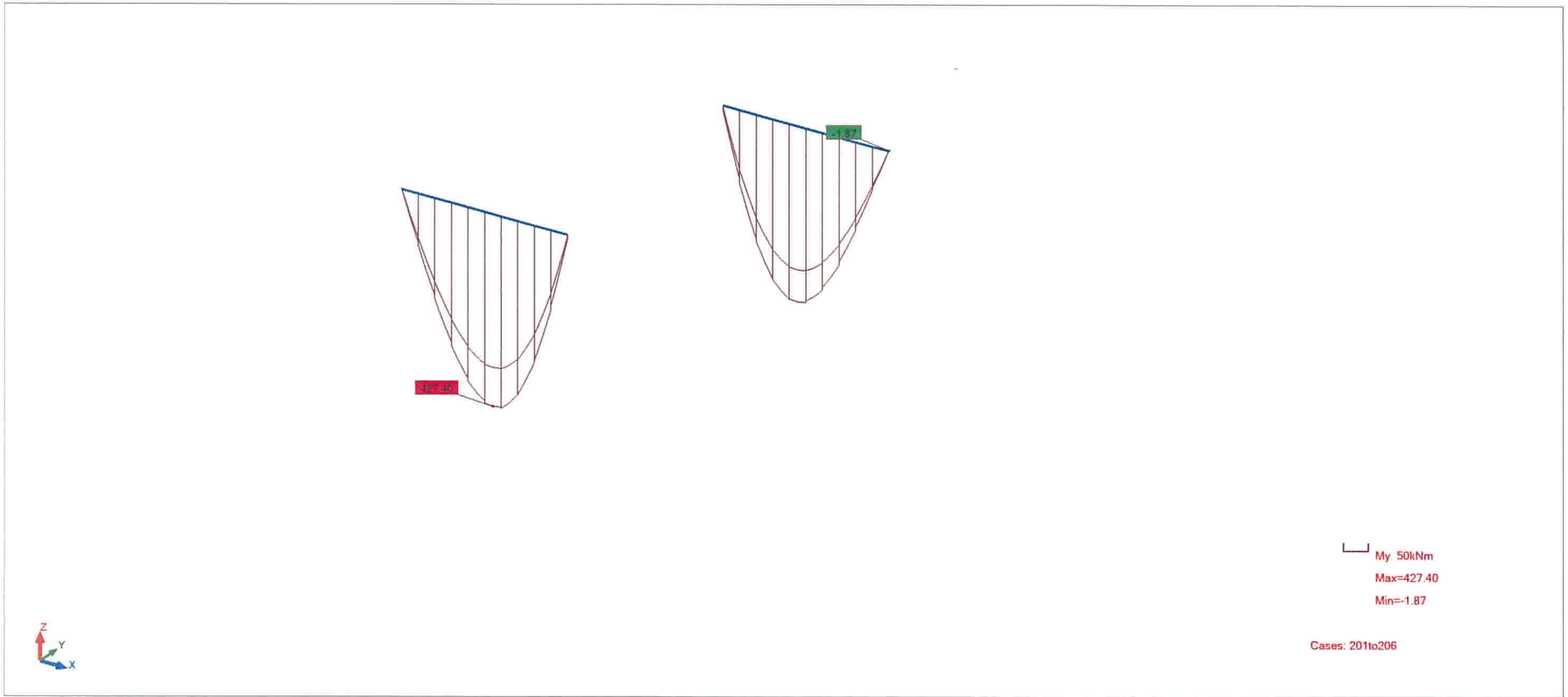
T3 max Bending envelope



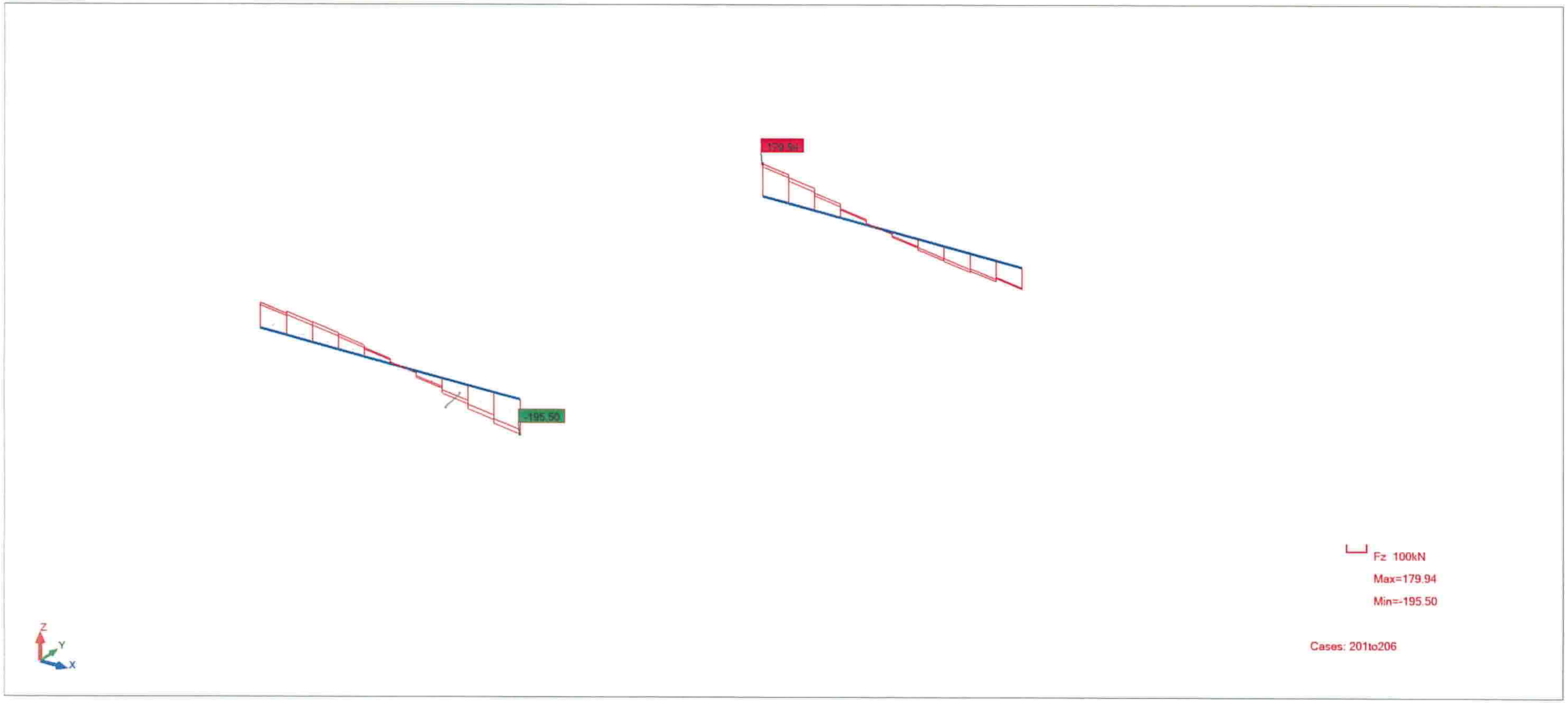
T3 Max Shear Envelope



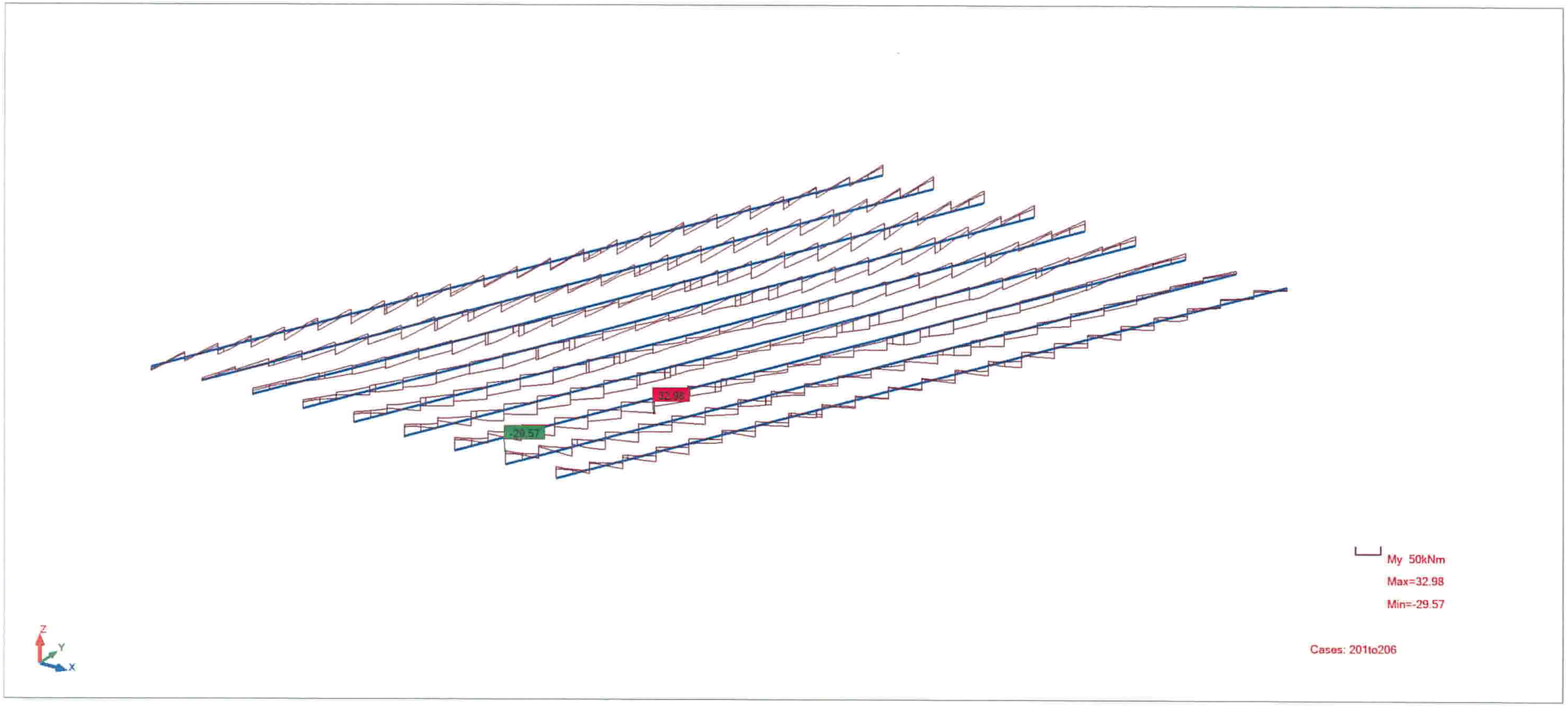
Parapet Edge Beam - Max bending Envelope



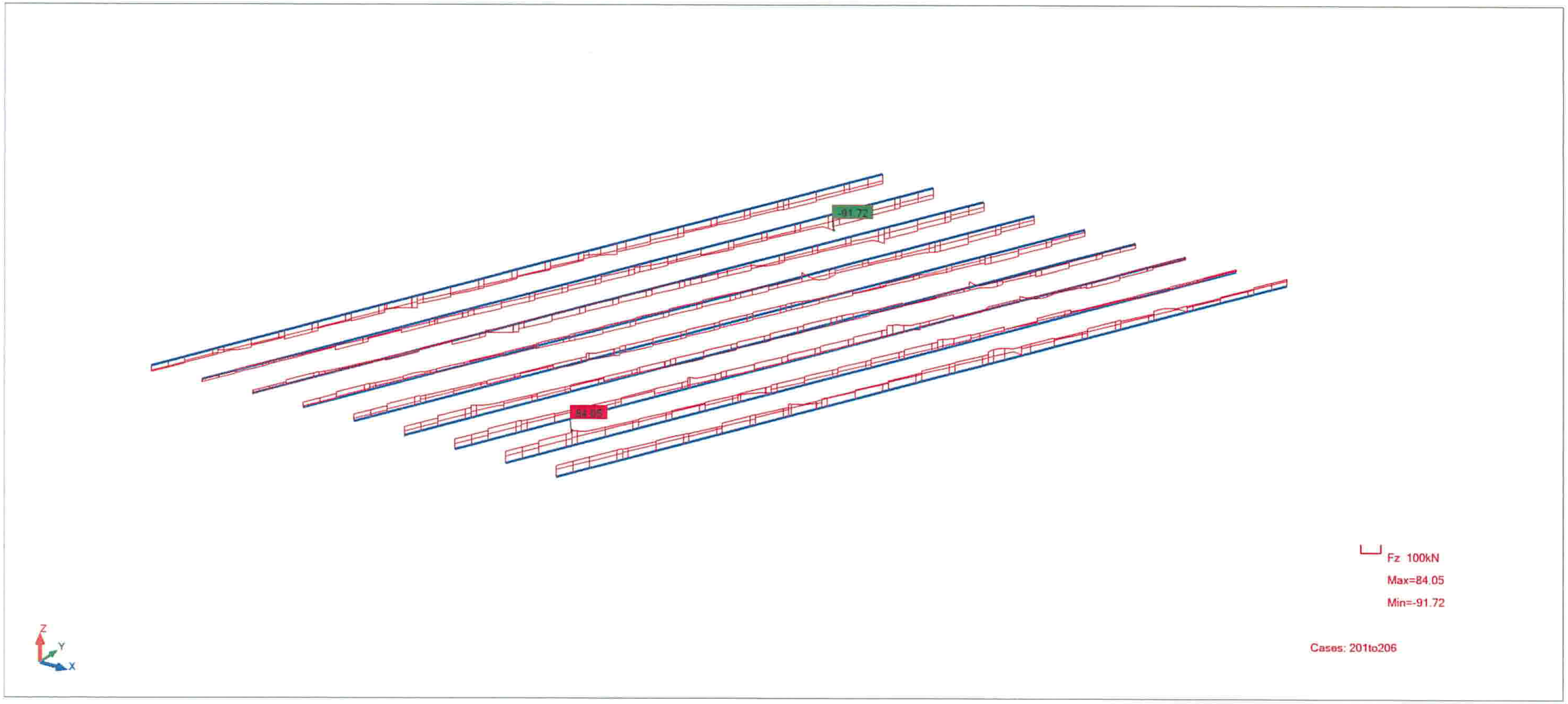
Parapet Edge Beams - Max Shear Envelope



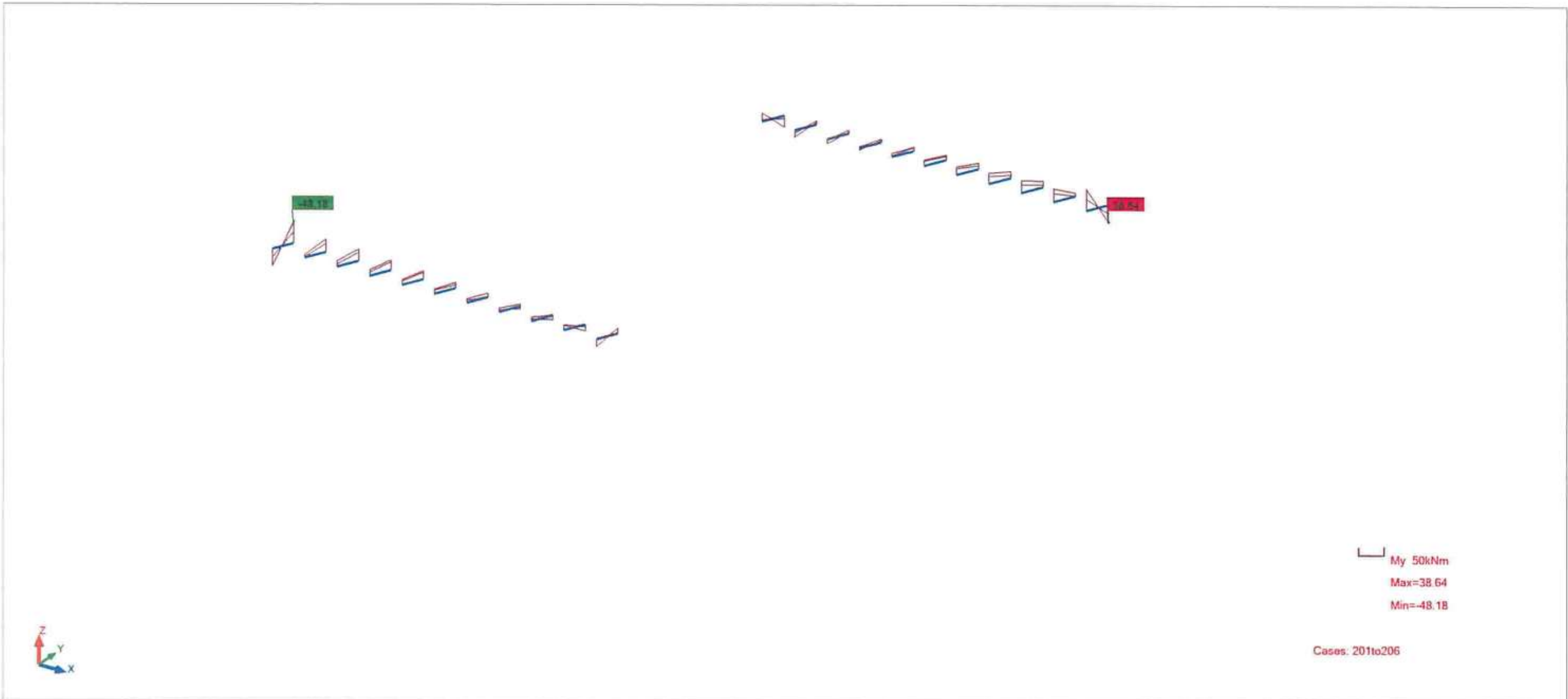
Transverse T1-T1 - Max Bending Envelope



Transverse T1 - T1 - Max Shear Ennvelope



Transverse T3 to T3 - max Bending envelope



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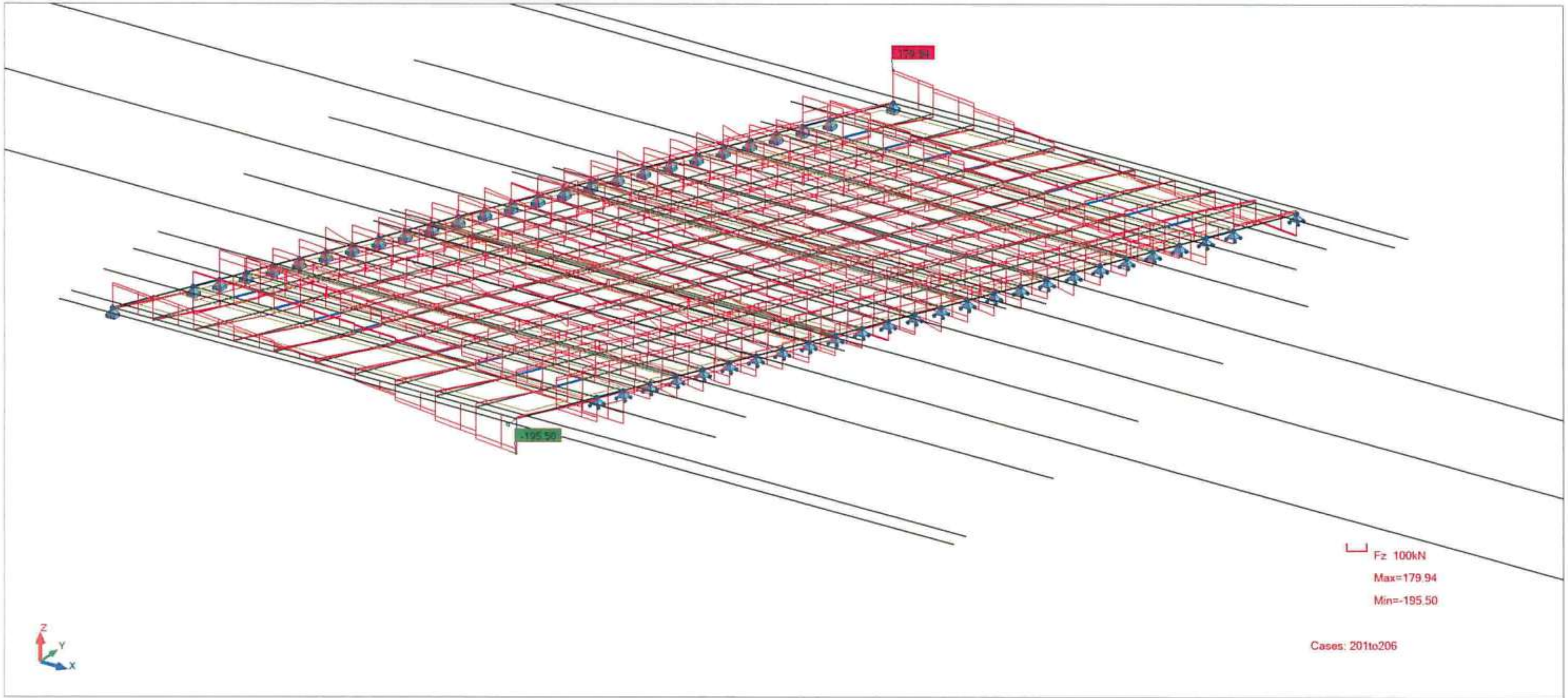
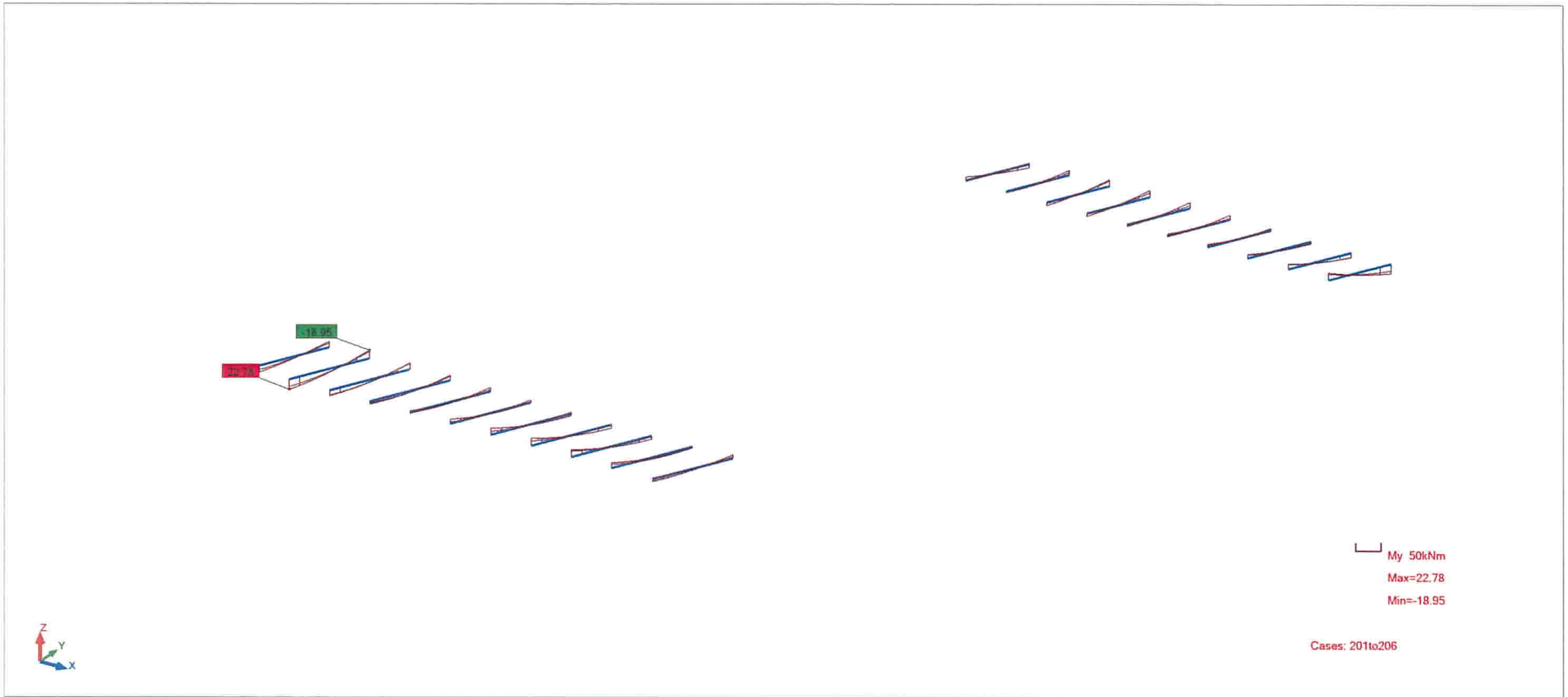
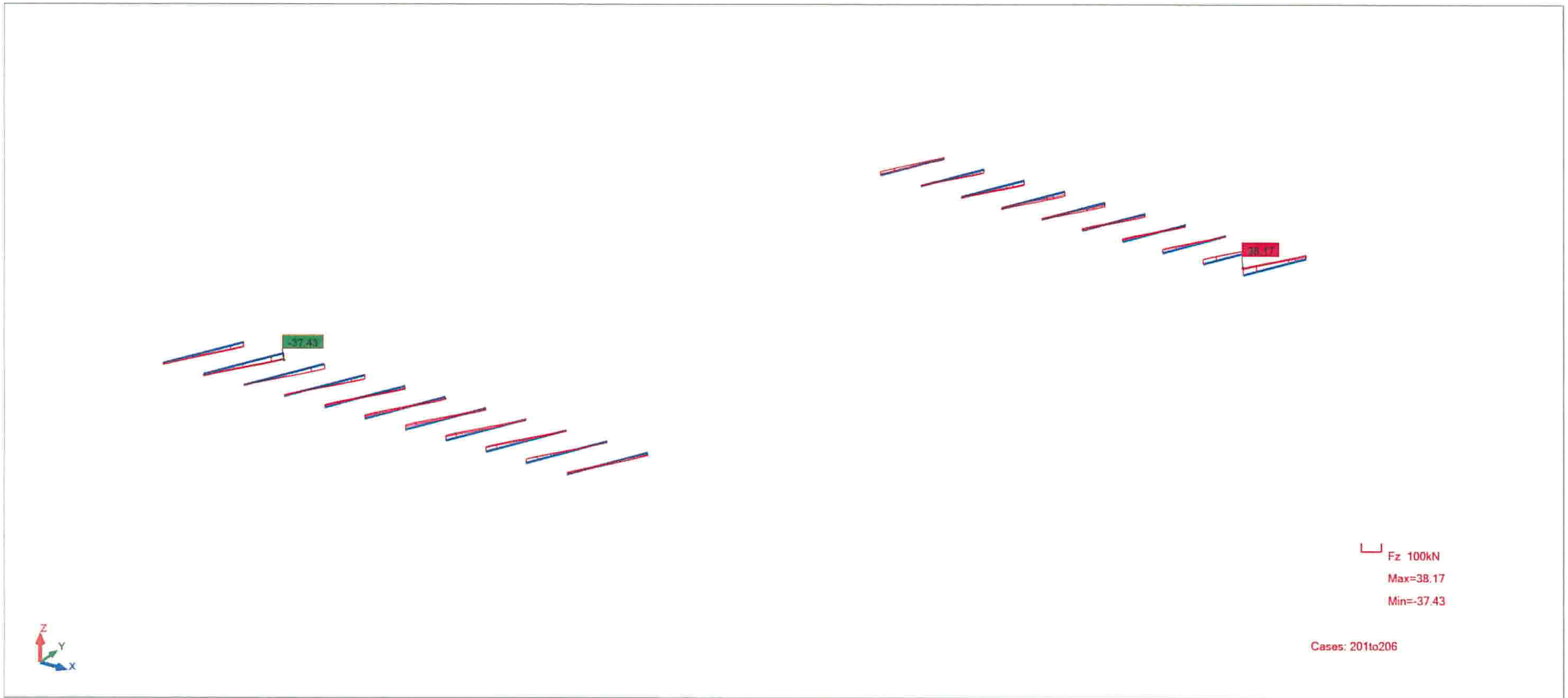
Transverse T3 to T3 - Max Shear Envelope



Transverse Footway Slab - Max Bending Envelope



Tranvserse Footway Slab - Max Shear Envelope



WALLACE STONE	Project : TOWNBRIDGE		
Calculation Sheet	Job No. : 2405	Made By :	RJ
Description:	Date : JULY 17	Checked :	
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Output

Results – ULS

T1 Beams ✓

Max ULS bending = 202.16 kN.m (sag)

Max ULS shear = 137.76 kN

T3 Beams ✓

Max ULS Bending = 334.91 kNm (sag)

Max ULS Shear = -183.86 kN

Parapet Edge Beam ✓

Max ULS bending = 427.56 kNm (sag)

Max ULS Shear = 196.64 kN (a support) = 111.28 kN (a 3d from support)

Transverse T1 – T1 ✓ (858 mm => 1/0.858 = 1.1655 for 1m wide strip)

Max ULS Bending = 38.65 kNm/m (sag) = 34.47 kNm/m (hog)

Max ULS shear = 105.2 kN/m

Transverse T3 - T3 (858 mm => 1/0.858 = 1.1655 for 1m wide strip)

Max ULS Bending = 17.29 kN.m/m (sag) = 34.05 kNm/m (hog)

Max ULS Shear = 52.48 kN/m

Transverse Footway ✓ (858mm => 1/0.858 = 1.655 for 1m wide strip)

Max ULS Bending = 26.56 kN.m/m (sag) = 22.08 kNm/m (hog)

Max ULS shear = 44.51 kN/m

WALLACE STONE	Project : TOWN BRIDGE	
Calculation Sheet	Job No. : 2405	Made By : RS
Description:	Date : 16/2/23	Checked :
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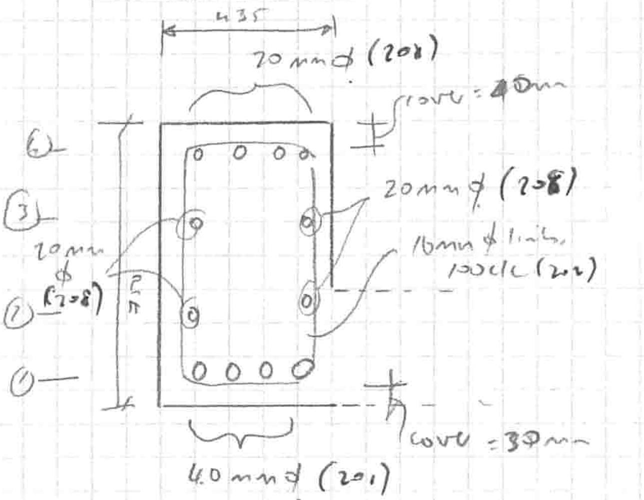
Output

Capacity

Parapet Edge Beams



Concrete grade = 45/20
∴ f_{cu} = 45 N/mm²

High yield ribbed rebar (1975)
f_y = 410 N/mm²

layer ① : 4 × 40mm ϕ ⇒ A_s = 4 × π × 20² = 5026.5 mm²
d = 750 − 30 − 16 − 20 = 684 mm

layer ② & ③ : 2 × 20 mm ϕ ⇒ A_s = 2 × π × 10² = 628.3 mm²
d = 684 − 210 = 479mm & 484 − 210 = 269 mm

layer ④ = 4 × 20 mm ϕ ⇒ A_s = 4 × π × 10² = 1256.6 mm²
d = 45 + 16 + 10 = 66 mm

A_{sv} = 2 × π × 8² = 402.1 mm² @ 100mm c/c

See following pages for calculations to CS 455

M_u 1073.4 kNm > 427.56 kNm . UR = 0.4

V_{max} = 1670.99 kN > 196.64 kN (anywhere on beam)

V_{uc} = 223.84 kN > 111.28 kN (beyond 3D from support

V_u @ 3d = 207.32 kN > 111.28 kN (within 3D from support

∴ Shear utilisation UR = 0.54

NOTE: Shear capacity does not include additional capacity from shear reinforcement.

Location: Parapet Edge Beam - 8.57m Span

Partial Factors for Materials - See Table 2.13 of CS 455

ULS - Table 2.13a

Reinforcement and Prestress Tendons - not 460 grade - Characteristic Strength $\gamma msuls := 1.15$

Concrete - Characteristic Strength $\gamma mculs := 1.5$

Shear in Concrete - Characteristic Strength $\gamma mvuls := 1.25$

Bond in Concrete - Characteristic Strength $\gamma mbuls := 1.4$

Moment resistance of Reinforced Beams at ULS - Section 5 - CS 455

Max ULS Bending Moment (M) from the ROBOT Model $M := 427.56\ kN \cdot m$

Characteristic concrete Strength, $fcu := 45\ \frac{N}{mm^2}$ Characteristic steel Strength, $fy := 410\ \frac{N}{mm^2}$

width of section in compression at n.a $b := 435\ mm$

Area of tension reinforcement $As := 5026.5\ mm^2$ effective depth of tension rebar from extreme comp. fibre $d := 684\ mm$

Eq 5.2.2b Lever Arm for beams without compression reinforcement

$$z := \left(1 - \frac{\left(0.84 \cdot \frac{(fy \cdot As)}{\gamma msuls}\right)}{\frac{(fcu \cdot b \cdot d)}{\gamma mculs}}\right) \cdot d = 568.649\ mm$$

$0.95\ d = 649.8\ mm$ z<0.95d, therefore OK

Eq 5.2.2a Moment Resistance for beams without compression reinforcement => Mu= Min. of Mu1 and Mu2

$$Mu1 := \left(\frac{fy}{\gamma msuls}\right) \cdot As \cdot z = 1019.052\ kN \cdot m$$

$$Mu2 := \left(\frac{0.225 \cdot fcu}{\gamma mculs}\right) \cdot b \cdot d^2 = 1373.742\ kN \cdot m$$

Therefore, $Mu := min(Mu1, Mu2) = 1019.052\ kN \cdot m$

M<Mu, therefore OK for single reinforced section

However, the beam has reinforcment within the compression zone. Check if effective.

Area of reinforcement in compression zone $As' := 1256.6\ mm^2$ effective depth of comp. rebar from extreme comp. fibre $d' := 66\ mm$

$$fs' := \frac{fy}{\left(\gamma msuls + \left(\frac{fy}{2000}\right)\right)} \qquad fs' := 302.6 \frac{N}{mm^2}$$

Eq 5.2.2d Force equilibrium at ULS for beams with zero net axial force

$$\frac{fy}{\gamma msuls} \cdot As = \frac{(0.6 \cdot fcu)}{\gamma mculs} \cdot b \cdot x + fs' \cdot As'$$

$$x := \frac{\left(\left(\frac{fy}{(\gamma msuls)} \cdot As\right) - fs' \cdot As'\right)}{\left(\frac{(0.6 \cdot fcu)}{\gamma mculs}\right) \cdot b} = 180.308\ mm$$

$$0.429 \cdot x = 77.352\ mm$$

d'<0.429x, therefore the compression reinforcement can be included

Eq 5.2.2c Moment of resistance for beams with compression reinforcement

$$Muc := \left(\frac{0.6 \cdot fcu}{\gamma mculs}\right) \cdot b \cdot x \cdot (d - 0.5 \cdot x) + fs' \cdot As' \cdot (d - d') = 1073.39\ kN \cdot m$$

M<Muc, therefore OK for double reinforced section
ULS Moment Capacity OK

Shear resistance of Reinforced Beams at ULS - Section 5 - CS 455

Max ULS Shear Force (V) from the ROBOT Model

$V1 := 196.64\ kN$ at support

$V2 := 111.28\ kN$ beyond 3D from support

cl 5.6 of CS 455 - Shear force V from Robot Model cannot exceed Vmax anywhere, Vuc more than 3D from support and Vu within 3D from support

Eq 5.6a - Vmax - Max Shear Beased on concrete crushing

$$Vmax := 0.36 \cdot \left(0.7 - \left(\frac{fcu}{250 \frac{N}{mm^2}}\right)\right) \cdot \left(\frac{fcu}{\gamma mculs}\right) \cdot b \cdot d = 1670.985\ kN$$

Vmax>V1 & V2 therefore, OK

Eq 5.6b - Vuc - Shear Resistance more than 3D from support

Depth Factor ξs $\qquad \xi s := \left(\frac{500}{d}\right)^{0.25} \qquad \xi s := 0.924$ but not less than 0.7

Ratio of longitudinal reinforcement ρs $\rho s := \left(\frac{100 \cdot As}{b \cdot d}\right) = 1.689$ but not less than 0.15 or greater than 3

Eq 5.6b $Vuc := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot \rho s^{\frac{1}{3}} \cdot fcu^{\frac{1}{3}} \cdot b \cdot d$ $Vuc := 223.84\ kN$
Vuc>V2 therefore, OK

Eq 5.6c - Vu - Shear Resistance within 3D from support

@d from support

Section 9 - for calculating the anchorage bond strength and anchorage resistance

$k := 1$ normal concrete
$\beta := 0.7$ Type 2 deformed bars in tension - table 9.1 - CS 455

$acon := 0.65$ for bars or strands enclosed by links
$c := 30\ mm$ cover to rebar
$\phi := 40\ mm$ bar diameter

$av := 684\ mm$
$la := av - c = 654\ mm$ effective anchorage length

$kcov := acon \cdot \left(0.5 + \frac{c}{\phi}\right) = 0.813$

$p := \pi \cdot \phi = 125.664\ mm$

Eq 9.1b Average anchorage bond strength $fub := \frac{(k \cdot kcov \cdot \beta \cdot \sqrt{fcu})}{\gamma mbuls}$ $fub := 2.727\ \frac{N}{mm^2}$

Eq 9.1a Anchorage resistance $Fub := fub \cdot p \cdot la = 224.116\ kN$

but not greater than $Fubmax := \frac{(As \cdot fy)}{\gamma msuls} = 1792.057\ kN$

Eq 5.6c Shear Resistance within 3D from support => Vu= Max. of Vu1 and Vu2

$Vu1 := \frac{3 \cdot d}{av} \cdot \Gamma \cdot Vuc$

$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d$

Eq 5.6d Factor to account for the effect of short anchorage lengths => Γ = Min. of $\Gamma 1$ and $\Gamma 2$

$\Gamma 1 := \sqrt{\left(\frac{z}{3 \cdot d} \cdot \frac{Fub}{Vuc}\right)} = 0.527$

$\Gamma 2 := 1.0$

$\Gamma := min(\Gamma 1, \Gamma 2) = 0.527$

Eq 5.6c - Vu2

$$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d \qquad Vu2 := 99.76\ kN$$

Eq 5.6c - Vu1

@d from support

$$Vu1 := \frac{3 \cdot d}{av} \Gamma \cdot Vuc = 353.72\ kN$$

Vu1>Vu2, Therefore, Vu=Vu1

Vu>V1, Therefore, Shear is acceptable at d from support

@3d from support

Section 9 - for calculating the anchorage bond strength and anchorage resistance

$k := 1$ normal concrete

$\beta := 0.7$ Type 2 deformed bars in tension - table 9.1 - CS 455

$acon := 0.65$ for bars or strands enclosed by links

$c := 30\ mm$ cover to rebar

$\phi := 40\ mm$ bar diameter

$av := 2052\ mm$

$la := av - c = 2022\ mm$ effective anchorage length

$$kcov := acon \cdot \left(0.5 + \frac{c}{\phi}\right) = 0.813$$

$$p := \pi \cdot \phi = 125.664\ mm$$

Eq 9.1b Average anchorage bond strength

$$fub := \frac{\left(k \cdot kcov \cdot \beta \cdot \sqrt{fcu}\right)}{\gamma mbuls} \qquad fub := 2.727\ \frac{N}{mm^2}$$

Eq 9.1a Anchorage resistance

$$Fub := fub \cdot p \cdot la = 692.909\ kN$$

but not greater than $Fubmax := \frac{(As \cdot fy)}{\gamma msuls} = 1792.057\ kN$

Eq 5.6c Shear Resistance within 3D from support => Vu= Max. of Vu1 and Vu2

$$Vu1 := \frac{3 \cdot d}{av} \cdot \Gamma \cdot Vuc$$

$$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d$$

Eq 5.6d Factor to account for the effect of short anchorage lengths => Γ = Min. of $\Gamma 1$ and $\Gamma 2$

$$\Gamma 1 := \sqrt{\left(\frac{z}{3 \cdot d} \cdot \frac{Fub}{Vuc}\right)} = 0.926$$

$$\Gamma 2 := 1.0$$

$$\Gamma := min(\Gamma 1, \Gamma 2) = 0.926$$

Eq 5.6c - Vu2

$$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d \qquad Vu2 := 99.76\ kN$$

Eq 5.6c - Vu1

@3d from support

$$Vu1 := \frac{3 \cdot d}{av} \Gamma \cdot Vuc = 207.32\ kN$$

Vu1>Vu2, Therefore, Vu=Vu1

Vu>V2, Therefore, Shear is acceptable at 3d from support

Vmax is greater than V anywhere on the beam,
Vuc is greater than V beyond D from support and
Vu is greater than V within 3D from support,
Therefore ULS Shear Capacity is acceptable

WALLACE STONE	Project : TOWNBRIDGE		
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Output

This is a different capacity to that calculated for the 2010 assessment.
Mu = 351.99kNm & Vu = 945.18kN

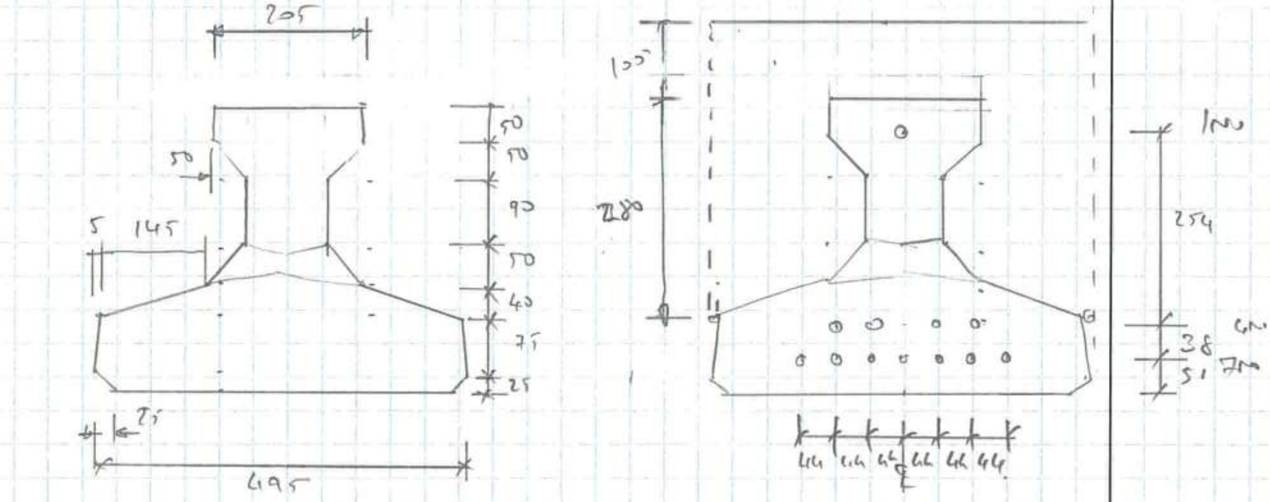
The section width square to the direction of the span is 435mm as per drawing B43/2/7.
However, the 2010 assessment calculations have a width of 410mm

The 2010 assessment calculations only assume 4 No 20mm diameter bars in the bottom of the beam rather than the 4 No 40mm diameter bars shown on section AA of drawing B43/2/7

Also the 2010 assessment calculations have assumed a fcu = 40 N/mm2 and not the 45 N/mm2

Output

T1 Beam



Prestress tendons 12.7m dia low relax stabilised to BS3617.

Area of steel = 94.2 mm^2 Length = 8.9m.
Characteristic load = 165 kN.
Min 0.2% proof load = 148.5 kN

Initial prestress force = 1392 kN (before losses) ∴ $\left(\frac{1392}{12}\right)/165$ = 0.7 ≈ 70%
eccentricity = 52mm
cube strength @ transfer = 40 N/mm².
fcu precast = 52.5/20.
fcu insitu = 45/20.
Min relaxation after 1000 hrs. = 2.5%

T1 Beam

Depth · 380 mm   Ac = 97365 mm^2 y_b = 140 mm

Z_t = 5.21 $mm^3 \times 10^6$ Z_b = 8.96 $mm^3 \times 10^6$ S/W = 2.45 kN/m
I = 1231 × 10^9 mm^4

layer 1 A_s = 7 × 94.2 = 659.4 mm^2

layer 2 A_s = 4 × 94.2 = 376.8 mm^2

layer 3 A_s = 94.2 mm^2

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Calculation Sheet	Job No. : 2405	Made By : RD
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Output

T1 Beam

stresses in beam.

Untactored loads - not including SW of beam + insitu slab

	Combo 2	Combo 1. only
- infill concrete	= 13.08 kNm	13.08
- surfacing	= 5.11 kNm	5.11
- parapet	= 1.87	1.87
- lane 3 max bending HA	= 25.87 kNm	25.87
- lane 3 max bending AIL	= 69.28 kNm	0
	115.13 kNm	45.9 kNm

long term stress loss in strands = 30.52%

Final force = 995.28 kN

% loss => 995.82 / 1392 = 0.715 = 28.5% loss

See Calculation sheets over

ULS M_u = 473.71 kNm > 201.16 kNm ∴ ok UR = 0.43

V_c => V_{max} = 1481.76 kN > 137.26 kN

V_{co} = 151.82 kN > 137.26 kN UR = 0.9

SLS Tension & compression within class 1 limits in accordance with Table 8.15a of CS 455

NOTE : Shear capacity does not include additional capacity from shear reinforcement

Location: T1 - 8.57m Span

Beam Section Properties - T1 Only

Span, $L:=8.57\ m$ Depth of Beam, $d:=0.38\ m$

Cross Sectional Area, $Ac:=97385\ mm^2$ Centroid above soffit, $Yb:=140\ mm$

Section Modulus Top, $Zt:=5.21\cdot10^6\ mm^3$ Section Modulus Bottom. $Zb:=8.96\cdot10^6\ mm^3$

Centroid below top, $Yt:=d-Yb=240\ mm$

Second Moment of Area, $Ixx:=Zb\cdot Yb=(1.254\cdot10^9)\ mm^4$ Thickness of web, $bweb:=105\ mm$

Unit Weight of Beam, $\gamma c:=25\ \frac{kN}{m^3}$

Self Weight of beam, $SW:=\gamma c\cdot Ac=2.435\ \frac{kN}{m}$

Beam strength at Transfer, $fci:=40\ \frac{N}{mm^2}$ Modulus of elasticity at transfer for concrete, $Eci:=31\ \frac{kN}{mm^2}$

Characteristic Beam Strength, $fcu:=52.5\ \frac{N}{mm^2}$ Modulus of elasticity for characteristic strength of concrete, $Ecmb:=34.5\ \frac{kN}{mm^2}$

Prestress Strands

Strand Diameter, $nomd:=12.7\ mm$ Tensile area, $noma:=94.2\ mm^2$

Tensile Strength, $nomt:=1751\ \frac{N}{mm^2}$ Characteristic Breaking Load, $cbl:=165\ kN$

Initial Force Per Strand, $if:=116\ kN$ Initial Stress Per Strand,

Modulus of Elasticity of strand, $Es:=200\ \frac{kN}{mm^2}$ $fs:=\frac{if}{noma}=1231.423\ \frac{N}{mm^2}$

Composite Section Properties

Composite Section is rectangular in shape

Breadth of section, $bi:=500\ mm$
Depth of section, $di:=480\ mm$
Area of in-situ concrete, $Ai:=bi\cdot di-Ac=142615\ mm^2$

Characteristic Insitu Concrete Strength, $fcuc:=45\ \frac{N}{mm^2}$ Modulus of elasticity for insitu concrete, $Ecmi:=32.5\ \frac{kN}{mm^2}$

Centroid of insitu concrete, $Yi := ((bi \cdot di \cdot (di \div 2)) - (Ac \cdot Yb)) \frac{1}{Ai} = 308.285\ mm$

Second Moment of Area of insitu concrete, $Ii := \left(\frac{(bi \cdot di^3)}{3}\right) - Ixx - (Ac \cdot Yb^2) - (Ai \cdot Yi^2) = (1.715 \cdot 10^9)\ mm^4$

Modular Ratio between precast and insitu concrete, $mr := \frac{Ecmi}{Ecmb} = 0.942$

Centroid of composite section $Yc := \left((Ac \cdot Yb + Ai \cdot Yi \cdot mr) \cdot \frac{1}{(Ac + Ai \cdot mr)}\right) = 237.564\ mm$

Second Moment of Area of insitu concrete, $Ic := Ixx + Ac \cdot (Yb - Yc)^2 + mr \cdot \left(Ii + Ai \cdot (Yi - Yc)^2\right) = (4.469 \cdot 10^9)\ mm^4$

Strand Arrangement

Section 1 - Midspan

Layer 1
Number of Strands, $ns11 := 7$ Height of layer, $nls11 := 50\ mm$

Layer 2
Number of Strands, $ns12 := 4$ Height of layer, $nls12 := 90\ mm$

Layer 3
Number of Strands, $ns13 := 1$ Height of layer, $nls13 := 340\ mm$

Total Number of Strands, $nos := ns11 + ns12 + ns13 = 12$

Total Area of Strands, $Aps := nos \cdot noma = 1130.4\ mm^2$

Total Initial Force, $P0 := nos \cdot if = 1392\ kN$

Centroid of strands above soffit, $cf := \left(\frac{ns11}{nos} \cdot nls11\right) + \left(\frac{ns12}{nos} \cdot nls12\right) + \left(\frac{ns13}{nos} \cdot nls13\right) = 87.5\ mm$

Eccentricity of strands, $e := Yb - cf = 52.5\ mm$

Section 1 - Midspan - Strands in the tension zone

Layer 1
Number of Strands, $ns11 := 7$ Height of layer, $nls11 := 50\ mm$

Layer 2
Number of Strands, $ns12 := 4$ Height of layer, $nls12 := 90\ mm$

Total Number of Strands in tension zone $nost := ns11 + ns12 = 11$

Total Area of Strands in tension zone, $Apst := nost \cdot noma = 1036.2\ mm^2$

Centroid of strands above soffit in tensions zone, $cft := \left(\frac{ns11}{nost} \cdot nls11\right) + \left(\frac{ns12}{nost} \cdot nls12\right) = 64.545\ mm$

Effective depth of tension strands, $dst := di - cft = 415.455\ mm$

Assessment of Prestress Force in accordance with Section 8 of CS455

8.5
1) Initial Prestress Force, $P0 := nos \cdot if = 1392\ kN$
2) the losses in prestress, and
3) the partial factor for prestress

8.7
1) Creep in concrete,
2) Shrinkage in concrete
3) relaxation in the prestressing steel
4) elastic deformation of concrete
5) movement of tendons at transfer at anchorages

6) effects of steam curing
7) friction
8) other causes of losses

8.8 Losses due to creep of concrete

Stresses at Transfer (Prestress Only)

Top of Beam $ftpt := \left(\frac{P0}{Ac}\right) - \left(P0 \cdot e \cdot \frac{Yt}{Ixx}\right) = 0.312\ \frac{N}{mm^2}$

Bottom of Beam $fbpt := \left(\frac{P0}{Ac}\right) + \left(P0 \cdot e \cdot \frac{Yb}{Ixx}\right) = 22.45\ \frac{N}{mm^2}$

Centroid of Strands $fcpt := \left(fbpt + (ftpt - fbpt) \cdot \frac{cf}{d}\right) = 17.352\ \frac{N}{mm^2}$

Stresses at Transfer (Selfweight of Beam)

Moment due to selfweight of beam $Mswb := \frac{(SW \cdot L^2)}{8} = 22.351\ kN \cdot m$

Top of Beam $ftswt := \frac{Mswb \cdot Yt}{Ixx} = 4.276\ \frac{N}{mm^2}$

Bottom of Beam $fbswt := -Mswb \cdot \frac{Yb}{Ixx} = -2.495\ \frac{N}{mm^2}$

Centroid of Strands $fcswt := \left(fbswt + (ftswt - fbswt) \cdot \frac{cf}{d}\right) = -0.935\ \frac{N}{mm^2}$

Total Stresses at Transfer

Top of Beam $tt := ftpt + ftswt = 4.588 \frac{N}{mm^2}$

Bottom of Beam $bt := fbpt + fbswt = 19.955 \frac{N}{mm^2}$

Centroid of Strands $ct := fcpt + fcswt = 16.417 \frac{N}{mm^2}$

Max Comp Stress at Transfer $\sigma ci := \max(tt, bt, ct) = 19.955 \frac{N}{mm^2}$

Refer to Table 8.8.3 - CS455

$fci := 40 \frac{N}{mm^2}$ $\sigma l := 0.33\ fci = 13.2 \frac{N}{mm^2}$ $\sigma u := 0.5\ fci = 20 \frac{N}{mm^2}$

Max Comp Stress at Transfer is **less** than and **greater** than therefore loss of prestress due to creep calculated using creep factor 48x10E-06 x $\sigma c := ct = 16.417 \frac{N}{mm^2}$

Loss of force due to creep $lfc := (48 \cdot 10^{-6} \cdot \sigma c \cdot Aps \cdot 200000) = 178.154\ kN$

Percentage loss $llc := \frac{lfc}{P0} \cdot 100 = 12.798\ \%$

8.9 Losses due to shrinkage of concrete

Refer to table 9.9.1 of CS 455 - conservatively assume normal exposure (i.e. 70% Relative Humidity) therefore the loss of force due to shrinkage of concrete is calculated using shrinkage factor 300x10E-06

Loss of force due to shrinkage of concrete $lfs := (300 \cdot 10^{-6}\ Aps \cdot Es) = 67.824\ kN$

Percentage loss $llc := \frac{lfs}{P0} \cdot 100 = 4.872\ \%$

8.10 Losses due to relaxation in the steel

Prestress tendons are 12.7mm diameter low relaxation stabilised to BS 3617

% initial load of characteristic breaking load $pibl := \frac{if}{cbl} \cdot 100 = 70.303\ \%$

Refer to table 3 of BS 3617 - applied prestress load is 70% of the Specific Characteristic Load therefore, maximum relaxation after 1000 hours from initial load = 2.5%

Loss of force due to relaxation of steel $lfrs := \frac{2.5}{100} \cdot P0 = 34.8\ kN$

Percentage loss $llc := \frac{lfrs}{P0} \cdot 100 = 2.5\ \%$

8.11 Losses due to elastic deformation of concrete

Calculation of elastic deformation of concrete based on short term elastic moduls of concrete and elastic modulus of tendons

Short term modulus of elasticity for normal weight concrete Eq3.5a $Ecm := (0.27 \cdot fci) + 20\ \frac{N}{mm^2} = 30.8\ \frac{N}{mm^2}$

$Es = 200000\ \frac{N}{mm^2}$

cl 8.11.2 For immediate loss of prestress in the tendons at transfer due to elastic deformation of the concrete may be calculated on a modular ratio basis using the stress in the adjacent concrete.

Multiplication factor for the concrete adjacent to the centroid of the strands $sas := 1 + e \cdot \frac{e \cdot Ac}{Ixx} = 1.214$

Loss of force due to elastic deformation of concrete $lfec := \frac{\left(P0 \cdot \frac{Es}{1000} \cdot Aps \cdot sas\right)}{Ac \cdot Ecm} = 127.371\ kN$

Percentage loss $lled := \frac{lfec}{P0} \cdot 100 = 9.15\ \%$

8.12 Losses at anchorages during transfer

Not relevant for prestressed concrete

8.13 Loss of prestress due to steam curing

Unlikely to be steam cured for this construction

8.14 Loss of prestress due to friction

Not relevant for prestressed concrete

Total losses in Prestress

Loss

1) Creep in concrete, $lfc = 178.154\ kN$
2) Shrinkage in concrete $lfs = 67.824\ kN$
3) relaxation in the prestressing steel $lfrs = 34.8\ kN$
4) elastic deformation of concrete $lfec = 127.371\ kN$

Total losses $loss := lfc + lfs + lfrs + lfec = 408.149\ kN$

Initial Force $P0 = 1392\ kN$

Final Force $Pf := P0 - loss = 983.851\ kN$

Final stresses in final concrete beam with insitu concrete loads

Moment due to insitu concrete $Mic := \frac{(Ai \cdot \gamma c \cdot L^2)}{8} = 32.732\ kN \cdot m$

Final Stresses (prestress)

Top of Beam $ftpf := \frac{Pf}{Ac} - Pf \cdot e \cdot \frac{Yt}{Ixx} = 0.22\ \frac{N}{mm^2}$

Bottom of Beam $fbpf := \frac{Pf}{Ac} + Pf \cdot e \cdot \frac{Yb}{Ixx} = 15.867\ \frac{N}{mm^2}$

Centroid of Strands $fcpf := \left(fbpf + (ftpf - fbpf) \cdot \frac{cf}{d}\right) = 12.264\ \frac{N}{mm^2}$

Final Stresses (with insitu concrete)

Top of beam $ftis := Mic \cdot \frac{Yt}{Ixx} = 6.263\ \frac{N}{mm^2}$

Bottom of beam $fbis := -\left(Mic \cdot \frac{Yb}{Ixx}\right) = -3.653\ \frac{N}{mm^2}$

Centroid of Strands $fcis := \left(fbis + (ftis - fbis) \cdot \frac{cf}{d}\right) = -1.37\ \frac{N}{mm^2}$

Final Stresses (prestress, sw beam & insitu concrete)

Top of beam $ftf := ftpf + ftswt + ftis = 10.759\ \frac{N}{mm^2}$

Bottom of beam $fbf := fbpf + fbswt + fbis = 9.72\ \frac{N}{mm^2}$

Centroid of Section $\sigma cp := \left(fbf + (ftf - fbf) \cdot \frac{Yb}{d}\right) = 10.103\ \frac{N}{mm^2}$

Composite Section

1) Max bending moment at midspan of beam (Infill concrete, surfacing, parapet and ALL Model 2 (CS454)) $Mc1b := 45.9\ kN \cdot m$

height from beam soffit to bottom of insitu concrete $hsis := 100\ mm$

Top of Insitu Section $ftsic1 := Mc1b \cdot \frac{(di - Yc)}{Ic} \cdot mr = 2.346\ \frac{N}{mm^2}$

Bottom of Insitu Section $fbsic1 := -Mc1b \cdot \frac{(Yc - hsis)}{Ic} \cdot mr = -1.331 \frac{N}{mm^2}$

Top of Beam $ftic1 := Mc1b \cdot \frac{(d - Yc)}{Ic} = 1.463 \frac{N}{mm^2}$

$ftc1f := ftf + ftic1 = 12.222 \frac{N}{mm^2}$

Bottom of Beam $fbic1 := -Mc1b \cdot \frac{(Yc)}{Ic} = -2.44 \frac{N}{mm^2}$

$fbc1f := fbf + fbic1 = 7.28 \frac{N}{mm^2}$

SLS Classes to table 8.15a - CS455

Max Comp Stress in prestressed element for load combination 1) $\sigma c1 := \max(ftc1f, fbc1f) = 12.222 \frac{N}{mm^2}$

$\gamma mc := 1.25$ Table 2.13b

Class 1, 2 & 3 compressive limit $\sigma climit := 0.5 \frac{fcu}{\gamma mc} = 21 \frac{N}{mm^2}$

Therefore, max compressive stress is within the compressive limits for class 1, 2 & 3 prestressed limits to Table 8.15a

Max tensile stress in prestressed element for load combination 1) $\sigma ct1 := min(ftc1f, fbc1f) = 7.28 \frac{N}{mm^2}$

No tensile stress. Therefore, max tensile stress is within the compressive limits for class 1, 2 & 3 prestressed limits to Table 8.15a

2) Max bending moment at midspan of beam (Infill concrete, surfacing, parapet and Max AIL) $Mc2b := 115.16\ kN \cdot m$

Top of Insitu Section $ftsic2 := Mc2b \cdot \frac{(di - Yc)}{Ic} \cdot mr = 5.886 \frac{N}{mm^2}$

Bottom of Insitu Section $fbsic2 := -Mc2b \cdot \frac{(Yc - hsis)}{Ic} \cdot mr = -3.34 \frac{N}{mm^2}$

Top of Beam $ftic2 := Mc2b \cdot \frac{(d - Yc)}{Ic} = 3.671 \frac{N}{mm^2}$

$ftc2f := ftf + ftic2 = 14.43 \frac{N}{mm^2}$

Bottom of Beam

$$fbic2 := -Mc2b \cdot \frac{(Yc)}{Ic} = -6.122 \frac{N}{mm^2}$$

$$fbc2f := fbf + fbic2 = 3.598 \frac{N}{mm^2}$$

SLS Classes to table 8.15a - CS455

Max Comp Stress in prestressed element for load combination 2)

$$\sigma c2 := \max(ftc2f, fbc2f) = 14.43 \frac{N}{mm^2}$$

$\gamma mc := 1.25$ Table 2.13b

Class 1, 2 & 3 compressive limit

$$\sigma climit := 0.5 \frac{fcu}{\gamma mc} = 21 \frac{N}{mm^2}$$

Therefore, max compressive stress is within the compressive limits for class 1, 2 & 3 prestressed limits to Table 8.15a

Max tensile stress in prestressed element for load combination 1)

$$\sigma ct2 := \min(ftc2f, fbc2f) = 3.598 \frac{N}{mm^2}$$

No tensile stress. Therefore, max tensile stress is within the compressive limits for class 1, 2 & 3 prestressed limits to Table 8.15a

Moment resistance of prestressed sections at ULS

Max ULS Bending Moment (M) from the ROBOT Model $M := 202.16\ kN \cdot m$

Eq 8.18.1b Tendon stress at failure $\gamma ms := 1.15$ Table 2.13a

$\alpha := 1.3$ Pre-tensioning

$$\sigma pb1 := \left(\alpha - \frac{(nomt \cdot Apst)}{fcu \cdot bi \cdot mr \cdot dst}\right) \cdot \left(\frac{nomt}{\gamma ms}\right) = 1710.485 \frac{N}{mm^2}$$

$$\sigma pb2 := \left(\frac{nomt}{\gamma ms}\right) = 1522.609 \frac{N}{mm^2}$$

$$\sigma pb := \min(\sigma pb1, \sigma pb2) = 1522.609 \frac{N}{mm^2}$$

Eq 8.18.1c Neutral Axis Depth at ULS $\gamma mculs := 1.5$ Table 2.13a

$$x := \frac{(\sigma pb \cdot Apst \cdot \gamma mculs)}{(0.6 \cdot fcu \cdot mr \cdot bi)} = 159.506\ mm$$

Eq 8.18.1a Moment of resistance of rectangular and flanged sections

$$Mu := \sigma pb \cdot Apst \cdot (d - 0.5\ x) = 473.707\ kN \cdot m$$

$$M := 202.16\ kN \cdot m$$

M<Mu Therefore, ULS Moment Capacity OK

Shear resistance of prestressed sections at ULS

Max ULS Shear Force (V) from the ROBOT Model

$$V := 137.26\ kN$$

cl 8.20 Using the additive approach (sum of resistances of concrete and steel) the shear force shall not exceed Vmax (Eq5.6a)

Eq 5.6a

$$Vmax := 0.36 \cdot \left(0.7 - \left(\frac{fcu}{250\ \frac{N}{mm^2}}\right)\right) \cdot \left(\frac{fcu}{\gamma mculs}\right) \cdot bi \cdot di = 1481.76\ kN$$

Vmax>V therefore, OK

cl 8.22 1) Vc shall be taken as Vco as per Eq 8.22b when M>Mcr as per Eq 8.22a

Eq 8.22a $M := 201.27\ kN \cdot m$ $\gamma fLp := 1.15$

$$fpt := fbpf = 15.867\ \frac{N}{mm^2} \qquad fpt1 := \frac{fpt}{\gamma fLp} = 13.798\ \frac{N}{mm^2}$$

$$Mcr := \left(0.49 \cdot \sqrt{\frac{fcu}{\gamma mculs}} + fpt1\right) \cdot \frac{Ic}{Yc} \qquad Mcr := 314.1\ kN \cdot m$$

M<Mcr, therefore Vc = Vco as per Eq 8.22b

Eq 8.22b Shear resistance of section uncracked in flexure

Eq 8.22b

$$ft := \frac{\left(0.32 \cdot \sqrt{\frac{fcu}{\gamma mculs}}\right)}{1000} \qquad ft := 1.893\ \frac{N}{mm^2}$$

$$\sigma cp = 10.103\ \frac{N}{mm^2} \qquad \sigma cp1 := \frac{\sigma cp}{\gamma fLp} = 8.785\ \frac{N}{mm^2} \qquad \frac{N}{mm^2} \qquad bweb := 105$$

$$Vco := \left(0.67 \cdot bweb \cdot di \cdot \sqrt{ft^2 + \sigma cp \cdot ft}\right) \qquad Vco := 151.82\ kN$$

Vc = Vco > V, Therefore, Shear Capacity is OK

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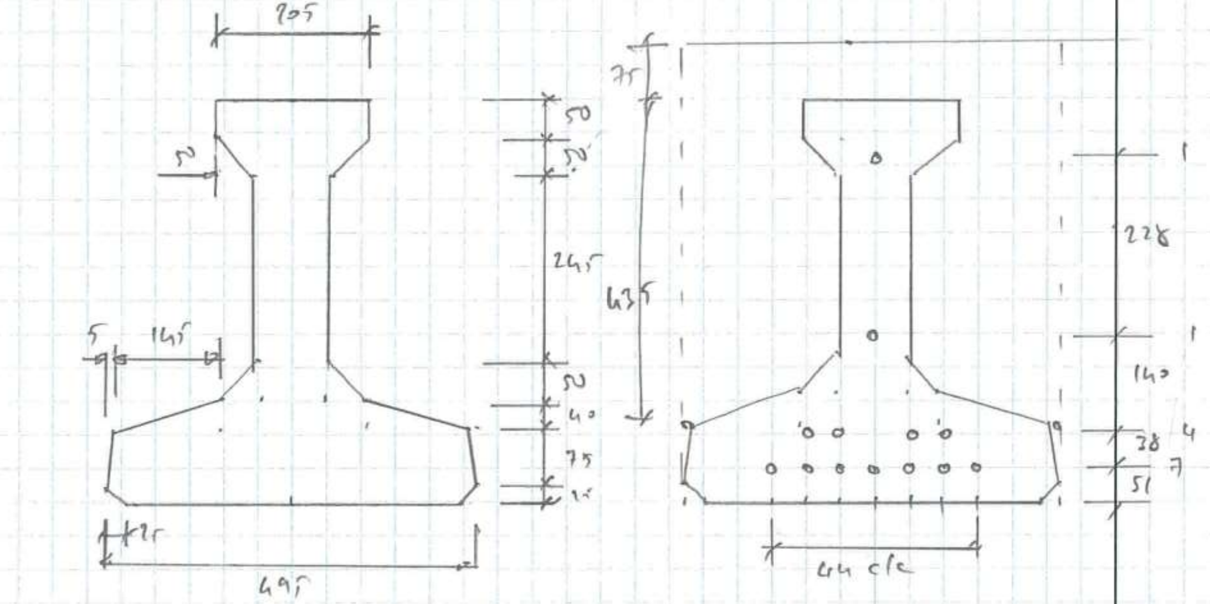
Output

T3 Beam



Prestress tendons 12.7 mm dia low relaxation to BS 5617

Area of steel = 94.2 mm²
Characteristic load = 165 kN
Min 0.2% proof load = 148.5 kN

length = 8.9 m

Initial prestress force = 1508 kN (before losses) ⇒ $\left(\frac{1508}{13}\right)/165$
= 0.7 ≈ 70%

eccentricity = 584 mm
cube strength = 40 N/mm²
fcu precast = 52.5/20
fcu in-situ = 45/20

Min relaxation after 1000 hrs = 2.5%

Depth = 535 mm   Ac = 114160 mm²   yb = 196 mm

Zt = 957 × 10³ mm³   Zb = 16.53 × 10⁶ mm³   S/w = 2.86 kN/m

I = 3.2426 × 10⁹ mm⁴

layer 1 As = 7 × 94.2 = 659.4 mm²   d = 580 mm

layer 2 As = 4 × 94.2 = 376.8 mm²   d = 520 mm

layer 3 As = 1 × 94.2 = 94.2 mm²   d = 380 mm

layer 4 As = 1 × 94.2 = 94.2 mm²   d = 150 mm

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Output

TJ Beam

Stresses in beam

Unfactored loads not including SW beam + insitu slab.

		Combo 2	Combo 1
– infill concrete	=	25.7	25.7
– surfacing	=	8.7	8.7
– parapet		19.53	19.53
– max bending HA (L1)	=	16.21	16.21
– max bending A1L (L1)	=	99.25	0
		169.392 kNm	70.14 kNm

long term losses in strands = 28.143% ∴ 71.86% of original

Final force = 1073.35 kN ∴ $1073.35 \times 10^3 / (13 \times 94.2)$

$= 876.5 \ N/mm^2$

See Calculations over

ULS Mr = 765.54 kNm > 334.91 kNm. Ur = 0.44.

Vc ⇒ Vmax. = 1883.07 kN > 183.56 kN

Vco = 187.35 kN > 183.56 kN UR = 0.98

SLS Tension and compression within class 1 limits in accordance with Table 8.15a of CS 455

NOTE: Shear capacity does not include additional capacity from shear reinforcement

Location: T3- 8.57m Span

Beam Section Properties - T3 Only

Span, $L := 8.57\ m$

Depth of Beam, $d := 0.535\ m$

Cross Sectional Area, $Ac := 114160\ mm^2$

Centroid above soffit, $Yb := 196\ mm$

Section Modulus Top, $Zt := 9.57 \cdot 10^6\ mm^3$

Section Modulus Bottom. $Zb := 16.53 \cdot 10^6\ mm^3$

Centroid below top, $Yt := d - Yb = 339\ mm$

Second Moment of Area, $Ixx := Zb \cdot Yb = \left(3.24 \cdot 10^9\right)\ mm^4$

Unit Weight of Beam, $\gamma c := 25\ \frac{kN}{m^3}$

Thickness of web, $bweb := 105\ mm$

Self Weight of beam, $SW := \gamma c \cdot Ac = 2.854\ \frac{kN}{m}$

Beam strength at Transfer, $fci := 40\ \frac{N}{mm^2}$

Modulus of elasticity at transfer for concrete, $Eci := 31\ \frac{kN}{mm^2}$

Characteristic Beam Strength, $fcu := 52.5\ \frac{N}{mm^2}$

Modulus of elasticity for characteristic strength of concrete, $Ecmb := 34.5\ \frac{kN}{mm^2}$

Prestress Strands

Strand Diameter, $nomd := 12.7\ mm$

Tensile area, $noma := 94.2\ mm^2$

Tensile Strength, $nomt := 1751\ \frac{N}{mm^2}$

Characteristic Breaking Load, $cbl := 165\ kN$

Initial Force Per Strand, $if := 116\ kN$

Initial Stress Per Strand,

Modulus of Elasticity of strand, $Es := 200\ \frac{kN}{mm^2}$

$fs := \frac{if}{noma} = 1231.423\ \frac{N}{mm^2}$

Composite Section Properties

Composite Section is rectangular in shape

Breadth of section, $bi := 500\ mm$

Depth of section, $di := 610\ mm$

Area of in-situ concrete, $Ai := bi \cdot di - Ac = 190840\ mm^2$

Characteristic Insitu Concrete Strength, $fcuc := 45\ \frac{N}{mm^2}$

Modulus of elasticity for insitu concrete, $Ecmi := 32.5\ \frac{kN}{mm^2}$

Centroid of insitu concrete, $Yi := ((bi \cdot di \cdot (di \div 2)) - (Ac \cdot Yb)) \dfrac{1}{Ai} = 370.204\ mm$

Second Moment of Area of insitu concrete, $Ii := \left(\dfrac{(bi \cdot di^3)}{3}\right) - Ixx - (Ac \cdot Yb^2) - (Ai \cdot Yi^2) = (4.05 \cdot 10^9)\ mm^4$

Modular Ratio between precast and insitu concrete, $mr := \dfrac{Ecmi}{Ecmb} = 0.942$

Centroid of composite section $Yc := \left((Ac \cdot Yb + Ai \cdot Yi \cdot mr) \cdot \dfrac{1}{(Ac + Ai \cdot mr)}\right) = 302.546\ mm$

Second Moment of Area of insitu concrete,

$$Ic := Ixx + Ac \cdot (Yb - Yc)^2 + mr \cdot \left(Ii + Ai \cdot (Yi - Yc)^2\right) = (9.174 \cdot 10^9)\ mm^4$$

Strand Arrangement

Section 1 - Midspan

Layer 1
Number of Strands, $ns11 := 7$ Height of layer, $nls11 := 50\ mm$

Layer 2
Number of Strands, $ns12 := 4$ Height of layer, $nls12 := 90\ mm$

Layer 3
Number of Strands, $ns13 := 1$ Height of layer, $nls13 := 230\ mm$

Layer 4
Number of Strands, $ns14 := 1$ Height of layer, $nls14 := 460\ mm$

Total Number of Strands, $nos := ns11 + ns12 + ns13 + ns14 = 13$

Total Area of Strands, $Aps := nos \cdot noma = 1224.6\ mm^2$

Total Initial Force, $P0 := nos \cdot if = 1508\ kN$

Centroid of strands above soffit,

$$cf := \left(\frac{ns11}{nos} \cdot nls11\right) + \left(\frac{ns12}{nos} \cdot nls12\right) + \left(\frac{ns13}{nos} \cdot nls13\right) + \left(\frac{ns14}{nos} \cdot nls14\right) = 107.692\ mm$$

Eccentricity of strands, $e := Yb - cf = 88.308\ mm$

Effective depth of strands, $dst := di - cf = 502.308\ mm$

Section 1 - Midspan - Strands in the tension zone

Layer 1

Number of Strands, $ns11 := 7$ Height of layer, $nls11 := 50\ mm$

Layer 2

Number of Strands, $ns12 := 4$ Height of layer, $nls12 := 90\ mm$

Layer 3

Number of Strands, $ns13 := 1$ Height of layer, $nls13 := 230\ mm$

Total Number of Strands in tensions zone $nost := ns11 + ns12 + ns13 = 12$

Total Area of Strands in tension zone, $Apst := nost \cdot noma = 1130.4\ mm^2$

Centroid of strands above soffit in tension zone,

$$cft := \left(\frac{ns11}{nost} \cdot nls11\right) + \left(\frac{ns12}{nost} \cdot nls12\right) + \left(\frac{ns13}{nost} \cdot nls13\right) = 78.333\ mm$$

Effective depth of tension strands in tension zone, $dst := di - cft = 531.667\ mm$

Assessment of Prestress Force in accordance with Section 8 of CS455

8.5

1) Initial Prestress Force, $P0 := nos \cdot if = 1508\ kN$
2) the losses in prestress, and
3) the partial factor for prestress

8.7

1) Creep in concrete,
2) Shrinkage in concrete
3) relaxation in the prestressing steel
4) elastic deformation of concrete
5) movement of tendons at transfer at anchorages

6) effects of steam curing
7) friction
8) other causes of losses

8.8 Losses due to creep of concrete

Stresses at Transfer (Prestress Only)

Top of Beam
$$ftpt := \left(\frac{P0}{Ac}\right) - \left(P0 \cdot e \cdot \frac{Yt}{Ixx}\right) = -0.724\ \frac{N}{mm^2}$$

Bottom of Beam
$$fbpt := \left(\frac{P0}{Ac}\right) + \left(P0 \cdot e \cdot \frac{Yb}{Ixx}\right) = 21.266\ \frac{N}{mm^2}$$

Centroid of Strands

$$fcpt := \left(fbpt + (ftpt - fbpt) \cdot \frac{cf}{d}\right) = 16.839\ \frac{N}{mm^2}$$

Stresses at Transfer (Selfweight of Beam)

Moment due to selfweight of beam $$Mswb := \frac{(SW \cdot L^2)}{8} = 26.201\ kN \cdot m$$

Top of Beam $$ftswt := \frac{Mswb \cdot Yt}{Ixx} = 2.742\ \frac{N}{mm^2}$$

Bottom of Beam $$fbswt := -Mswb \cdot \frac{Yb}{Ixx} = -1.585\ \frac{N}{mm^2}$$

Centroid of Strands $$fcswt := \left(fbswt + (ftswt - fbswt) \cdot \frac{cf}{d}\right) = -0.714\ \frac{N}{mm^2}$$

Total Stresses at Transfer

Top of Beam $$tt := ftpt + ftswt = 2.017\ \frac{N}{mm^2}$$

Bottom of Beam $$bt := fbpt + fbswt = 19.681\ \frac{N}{mm^2}$$

Centroid of Strands $$ct := fcpt + fcswt = 16.125\ \frac{N}{mm^2}$$

Max Comp Stress at Transfer $$\sigma ci := \max(tt, bt, ct) = 19.681\ \frac{N}{mm^2}$$

Refer to Table 8.8.3 - CS455

$$fci := 40\ \frac{N}{mm^2} \qquad \sigma l := 0.33\ fci = 13.2\ \frac{N}{mm^2} \qquad \sigma u := 0.5\ fci = 20\ \frac{N}{mm^2}$$

Max Comp Stress at Transfer σci is **less** than σu and **greater** than σl therefore loss of prestress due to creep calculated using creep factor 48x10E-06 x σc

$$\sigma c := ct = 16.125\ \frac{N}{mm^2}$$

Loss of force due to creep $$lfc := (48 \cdot 10^{-6} \cdot \sigma c \cdot Aps \cdot 200000) = 189.569\ kN$$

Percentage loss $$llc := \frac{lfc}{P0} \cdot 100 = 12.571\ \%$$

8.9 Losses due to shrinkage of concrete

Refer to table 9.9.1 of CS 455 - conservatively assume normal exposure (i.e. 70% Relative Humidity) therefore the loss of force due to shrinkage of concrete is calculated using shrinkage factor 300x10E-06

Loss of force due to shrinkage of concrete $lfs := \left(300 \cdot 10^{-6}\ Aps \cdot Es\right) = 73.476\ kN$

Percentage loss $llc := \frac{lfs}{P0} \cdot 100 = 4.872\ \%$

8.10 Losses due to relaxation in the steel

Prestress tendons are 12.7mm diameter low relaxation stabilised to BS 3617

% initial load of characteristic breaking load $pibl := \frac{if}{cbl} \cdot 100 = 70.303\ \%$

Refer to table 3 of BS 3617 - applied prestress load is 70% of the Specific Characteristic Load therefore, maximum relaxation after 1000 hours from initial load = 2.5%

Loss of force due to relaxation of steel $lfrs := \frac{2.5}{100} \cdot P0 = 37.7\ kN$

Percentage loss $llc := \frac{lfrs}{P0} \cdot 100 = 2.5\ \%$

8.11 Losses due to elastic deformation of concrete

Calculation of elastic deformation of concrete based on short term elastic moduls of concrete and elastic modulus of tendons

Short term modulus of elasticity for normal weight concrete Eq3.5a $Ecm := (0.27 \cdot fci) + 20\ \frac{N}{mm^2} = 30.8\ \frac{N}{mm^2}$

$Es = 200000\ \frac{N}{mm^2}$

cl 8.11.2 For immediate loss of prestress in the tendons at transfer due to elastic deformation of the concrete may be calculated on a modular ratio basis using the stress in the adjacent concrete.

Multiplication factor for the concrete adjacent to the centroid of the strands $sas := 1 + e \cdot \frac{e \cdot Ac}{Ixx} = 1.275$

Loss of force due to elastic deformation of concrete $lfec := \frac{\left(P0 \cdot \frac{Es}{1000} \cdot Aps \cdot sas\right)}{Ac \cdot Ecm} = 133.905\ kN$

Percentage loss $lled := \frac{lfec}{P0} \cdot 100 = 8.88$ %

8.12 Losses at anchorages during transfer
Not relevant for prestressed concrete

8.13 Loss of prestress due to steam curing
Unlikely to be steam cured for this construction

8.14 Loss of prestress due to friction
Not relevant for prestressed concrete

Total losses in Prestress
Loss

1) Creep in concrete, $lfc = 189.569\ kN$
2) Shrinkage in concrete $lfs = 73.476\ kN$
3) relaxation in the prestressing steel $lfrs = 37.7\ kN$
4) elastic deformation of concrete $lfec = 133.905\ kN$

Total losses $loss := lfc + lfs + lfrs + lfec = 434.649\ kN$

Initial Force $P0 = 1508\ kN$
Final Force $Pf := P0 - loss = 1073.351\ kN$

Final stresses in final concrete beam with insitu concrete loads

Moment due to insitu concrete $Mic := \frac{(Ai \cdot \gamma c \cdot L^2)}{8} = 43.801\ kN \cdot m$

Final Stresses (prestress)

Top of Beam $ftpf := \frac{Pf}{Ac} - Pf \cdot e \cdot \frac{Yt}{Ixx} = -0.516\ \frac{N}{mm^2}$

Bottom of Beam $fbpf := \frac{Pf}{Ac} + Pf \cdot e \cdot \frac{Yb}{Ixx} = 15.136\ \frac{N}{mm^2}$

Centroid of Strands $fcpf := \left(fbpf + (ftpf - fbpf) \cdot \frac{cf}{d}\right) = 11.986\ \frac{N}{mm^2}$

Final Stresses (with insitu concrete)

Top of beam $ftis := Mic \cdot \frac{Yt}{Ixx} = 4.583\ \frac{N}{mm^2}$

Bottom of beam $fbis := -\left(Mic \cdot \frac{Yb}{Ixx}\right) = -2.65\ \frac{N}{mm^2}$

Centroid of Strands $fcis := \left(fbis + (ftis - fbis) \cdot \frac{cf}{d}\right) = -1.194 \frac{N}{mm^2}$

Final Stresses (prestress, sw beam & insitu concrete)

Top of beam $ftf := ftpf + ftswt + ftis = 6.809 \frac{N}{mm^2}$

Bottom of beam $fbf := fbpf + fbswt + fbis = 10.901 \frac{N}{mm^2}$

Centroid of Section $\sigma cp := \left(fbf + (ftf - fbf) \cdot \frac{Yb}{d}\right) = 9.402 \frac{N}{mm^2}$

Composite Section

1) Max SLS bending moment at midspan of beam (Infill concrete, surfacing, parapet and ALL Model 2 (CS454)) $Mc1b := 70.14\ kN \cdot m$

height from beam soffit to bottom of insitu concrete $hsis := 75\ mm$

Top of Insitu Section $ftsic1 := Mc1b \cdot \frac{(di - Yc)}{Ic} \cdot mr = 2.214 \frac{N}{mm^2}$

Bottom of Insitu Section $fbsic1 := -Mc1b \cdot \frac{(Yc - hsis)}{Ic} \cdot mr = -1.639 \frac{N}{mm^2}$

Top of Beam $ftic1 := Mc1b \cdot \frac{(d - Yc)}{Ic} = 1.777 \frac{N}{mm^2}$

$ftc1f := ftf + ftic1 = 8.586 \frac{N}{mm^2}$

Bottom of Beam $fbic1 := -Mc1b \cdot \frac{(Yc)}{Ic} = -2.313 \frac{N}{mm^2}$

$fbc1f := fbf + fbic1 = 8.588 \frac{N}{mm^2}$

<u>SLS Classes to table 8.15a - CS455</u>

Max Comp Stress in prestressed element for load combination 1) $\sigma c1 := \max(ftc1f, fbc1f) = 8.588 \frac{N}{mm^2}$

$\gamma mc := 1.25$ Table 2.13b

Class 1, 2 & 3 compressive limit $\sigma climit := 0.5 \frac{fcu}{\gamma mc} = 21 \frac{N}{mm^2}$

Therefore, max compressive stress is within the compressive limits for class 1, 2 & 3 prestressed limits to Table 8.15a

Max tensile stress in prestressed element for load combination 1) $\sigma ct1 := min(ftc1f, fbc1f) = 8.586 \frac{N}{mm^2}$

No tensile stress. Therefore, max tensile stress is within the compressive limits for class 1, 2 & 3 prestressed limits to Table 8.15a

2) Max SLS bending moment at midspan of beam (Infill concrete, surfacing, parapet and Max AIL) $Mc2b := 169.39\ kN \cdot m$

Top of Insitu Section $ftsic2 := Mc2b \cdot \frac{(di - Yc)}{Ic} \cdot mr = 5.348 \frac{N}{mm^2}$

Bottom of Insitu Section $fbsic2 := -Mc2b \cdot \frac{(Yc - hsis)}{Ic} \cdot mr = -3.958 \frac{N}{mm^2}$

Top of Beam $ftic2 := Mc2b \cdot \frac{(d - Yc)}{Ic} = 4.292 \frac{N}{mm^2}$

$ftc2f := ftf + ftic2 = 11.101 \frac{N}{mm^2}$

Bottom of Beam $fbic2 := -Mc2b \cdot \frac{(Yc)}{Ic} = -5.586 \frac{N}{mm^2}$

$fbc2f := fbf + fbic2 = 5.315 \frac{N}{mm^2}$

SLS Classes to table 8.15a - CS455

Max Comp Stress in prestressed element for load combination 2) $\sigma c2 := \max(ftc2f, fbc2f) = 11.101 \frac{N}{mm^2}$

$\gamma mc := 1.25$ Table 2.13b

Class 1, 2 & 3 compressive limit $\sigma climit := 0.5 \frac{fcu}{\gamma mc} = 21 \frac{N}{mm^2}$

Therefore, max compressive stress is within the compressive limits for class 1, 2 & 3 prestressed limits to Table 8.15a

Max tensile stress in prestressed element for load combination 1) $\sigma ct2 := min(ftc2f, fbc2f) = 5.315 \frac{N}{mm^2}$

No tensile stress. Therefore, max tensile stress is within the compressive limits for class 1, 2 & 3 prestressed limits to Table 8.15a

Moment resistance of prestressed sections at ULS

Max ULS Bending Moment (M) from the ROBOT Model

$M := 334.91\ kN \cdot m$

Eq 8.18.1b Tendon stress at failure

$\gamma ms := 1.15$ Table 2.13a

$\alpha := 1.3$ Pre-tensioning

$$\sigma pb1 := \left(\alpha - \frac{(nomt \cdot Apst)}{fcu \cdot mr \cdot bi \cdot dst}\right) \cdot \left(\frac{nomt}{\gamma ms}\right) = 1750.16\ \frac{N}{mm^2}$$

$$\sigma pb2 := \left(\frac{nomt}{\gamma ms}\right) = 1522.609\ \frac{N}{mm^2}$$

$$\sigma pb := min(\sigma pb1, \sigma pb2) = 1522.609\ \frac{N}{mm^2}$$

Eq 8.18.1c Neutral Axis Depth at ULS

$\gamma mculs := 1.5$ Table 2.13a

$$x := \frac{(\sigma pb \cdot Apst \cdot \gamma mculs)}{(0.6 \cdot fcu \cdot mr \cdot bi)} = 174.007\ mm$$

Eq 8.18.1a Moment of resistance of rectangular and flanged sections

$$Mu := \sigma pb \cdot Apst \cdot (dst - 0.5\ x) = 765.335\ kN \cdot m$$

$M := 334.91\ kN \cdot m$

M<Mu Therefore, ULS Moment Capacity OK

Shear resistance of prestressed sections at ULS

Max ULS Shear Force (V) from the ROBOT Model

$V := 183.86\ kN$

cl 8.20 Using the additive approach (sum of resistances of concrete and steel Vc + Vs) the shear force shall not exceed Vmax (Eq5.6a)

Eq 5.6a

$$Vmax := 0.36 \cdot \left(0.7 - \left(\frac{fcu}{250\ \frac{N}{mm^2}}\right)\right) \cdot \left(\frac{fcu}{\gamma mculs}\right) \cdot bi \cdot di = 1883.07\ kN$$

Vmax>V therefore, OK

cl 8.22 1) Vc shall be taken as Vco as per Eq 8.22b when M>Mcr as per Eq 8.22a

Eq 8.22a $M := 334.91\ kN \cdot m$ $\gamma fLp := 1.15$

$fpt := fbpf = 15.136\ \frac{N}{mm^2}$ $fpt1 := \frac{fpt}{\gamma fLp} = 13.162\ \frac{N}{mm^2}$

$Mcr := \left(0.49 \cdot \sqrt{\frac{fcu}{\gamma mculs}} + fpt1\right) \cdot \frac{Ic}{Yc}$ $Mcr := 487\ kN \cdot m$

M<Mcr, therefore Vc = Vco as per Eq 8.22b

Eq 8.22b Shear resistance of section uncracked in flexure

Eq 8.22b

$ft := \frac{\left(0.32 \cdot \sqrt{\frac{fcu}{\gamma mculs}}\right)}{1000}$ $ft := 1.893\ \frac{N}{mm^2}$

$\sigma cp = 9.402\ \frac{N}{mm^2}$ $\sigma cp1 := \frac{\sigma cp}{\gamma fLp} = 8.176\ \frac{N}{mm^2}$

$bweb := 105\ mm$

$Vco := \left(0.67 \cdot bweb \cdot di \cdot \sqrt{ft^2 + \sigma cp \cdot ft}\right)$ $Vco := 187.35\ kN$

Vc = Vco > V, Therefore, Shear Capacity is OK

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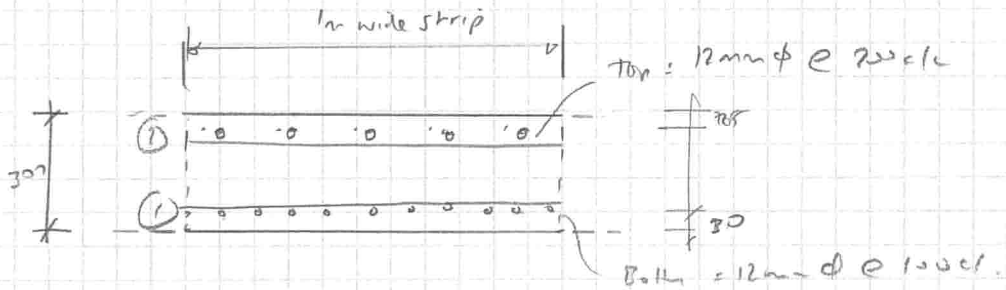
Output

Capacity

Footway slab - transverse spanning



Concrete grade = 45/20 f_{cu} = 45 N/mm²

High yield ribbed rebar (1975) f_y = 410 N/mm²

Area layer (1) = $10 \times \pi \times 6^2$ = 1131 mm²/m d = 300 - 30 - 6 = 264 mm

" layer (2) = $5 \times \pi \times 6^2$ = 565.5 mm²/m d = 25 + 6 = 31

See following SAND/SCALE print out.

SAL

Mr = 101.13 kNm/m > 26.56 kNm/m ∴ ok UR = 0.26

HSL

Mr = 51.52 kNm/m > 22.1 kNm/m ∴ ok UR = 0.43

Shear

Vmax = 1482.62 kN/m > 44.51 kN/m

Vuc = 112.37 kN/m > 44.51 kN/m UR = 0.4

Location: Transverse Spanning Footway Slab

Partial Factors for Materials - See Table 2.13 of CS 455

ULS - Table 2.13a

Reinforcement and Prestress Tendons - not 460 grade - Characteristic Strength $\gamma msuls := 1.15$

Concrete - Characteristic Strength $\gamma mculs := 1.5$

Shear in Concrete - Characteristic Strength $\gamma mvuls := 1.25$

Bond in Concrete - Characteristic Strength $\gamma mbuls := 1.4$

Moment resistance of Reinforced Slabs at ULS - Section 6 - CS 455

Footway slab modelled as one way spanning in ROBOT grillage Model orthogonal to the transverse reinforcement, therefore no biaxial bending considered.
In accordance with clause 6.1 the one way spanning slab moment capacity shall be calculated using the same assumptions for reinforced concrete beams

Max ULS Bending Moment (M) from the ROBOT Model in the

$Msag := 26.56\ kN \cdot m$ per metre wide strip

$Mhog := 22.1\ kN \cdot m$ per metre wide strip

Characteristic concrete Strength, $fcu := 45\ \frac{N}{mm^2}$ Characteristic steel Strength, $fy := 410\ \frac{N}{mm^2}$

width of section in compression at n.a $b := 1000\ mm$

Sagging Moment Capacity

Assume singular layer of reinforcement as top layer will be restraining the hogging moments over the supports

Area of bottom reinforcement $As1 := 1131\ mm^2$ effective depth of tension rebar from extreme comp. fibre $d1 := 264\ mm$

Eq 5.2.2b Lever Arm for beams without compression reinforcement

$$z := \left(1 - \frac{\left(0.84 \cdot \frac{(fy \cdot As1)}{\gamma msuls}\right)}{\frac{(fcu \cdot b \cdot d1)}{\gamma mculs}}\right) \cdot d1 = 252.71\ mm$$

$0.95\ d1 = 250.8\ mm$ z>0.95d, therefore not OK

$z := 250.8\ mm$

Eq 5.2.2a Moment Resistance for beams without compression reinforcement => Mu= Min. of Mu1 and Mu2

$$Mu1 := \left(\frac{fy}{\gamma msuls}\right) \cdot As1 \cdot z = 101.129\ kN \cdot m$$

per metre wide strip

$$Mu2 := \left(\frac{0.225 \cdot fcu}{\gamma mculs}\right) \cdot b \cdot d1^2 = 470.448\ kN \cdot m$$

per metre wide strip

Therefore, $Mu := min(Mu1, Mu2) = 101.129\ kN \cdot m$

per metre wide strip

Msag<Mu, therefore OK for single reinforced section

<u>Hogging Moment Capacity</u>

Assume singular layer of reinforcement as bottom layer will be restraining the sagging moments over the supports

Area of bottom reinforcement $As2 := 565.5\ mm^2$ effective depth of tension rebar from extreme comp. fibre $d2 := 269\ mm$

Eq 5.2.2b Lever Arm for beams without compression reinforcement

$$z := \left(1 - \frac{\left(0.84 \cdot \frac{(fy \cdot As2)}{\gamma msuls}\right)}{\frac{(fcu \cdot b \cdot d2)}{\gamma mculs}}\right) \cdot d2 = 263.355\ mm$$

$0.95\ d2 = 255.55\ mm$ z<0.95d, therefore not OK

$z := 255.55\ mm$

Eq 5.2.2a Moment Resistance for beams without compression reinforcement => Mu= Min. of Mu1 and Mu2

$$Mu1 := \left(\frac{fy}{\gamma msuls}\right) \cdot As2 \cdot z = 51.522\ kN \cdot m$$

per metre wide strip

$$Mu2 := \left(\frac{0.225 \cdot fcu}{\gamma mculs}\right) \cdot b \cdot d2^2 = 488.437\ kN \cdot m$$

per metre wide strip

Therefore, $Mu := min(Mu1, Mu2) = 51.522\ kN \cdot m$

per metre wide strip

Mhog<Mu, therefore OK for single reinforced section

Shear resistance of reinforced slabs at ULS - Section 5 - CS 455

Shear resistance in slabs as per cl 6.5 of CS 455. Shear resistance to be calculated as per section 5 (beams) except for Vuc more than 3D from support. However, span is short and all of slab within 3D from support.

Max ULS Shear Force (V) from the ROBOT Model

$V1 := 44.51\ kN$ per metre wide strip at support

$V2 := ▯$ N/A per metre wide strip beyond 3D from support

cl 5.6 of CS 455 - Shear force V from Robot Model cannot exceed Vmax anywhere, Vuc more than 3D from support and Vu within 3D from support

Eq 5.6a - Vmax - Max Shear Based on concrete crushing

$$Vmax := 0.36 \cdot \left(0.7 - \left(\frac{fcu}{250 \frac{N}{mm^2}}\right)\right) \cdot \left(\frac{fcu}{\gamma mculs}\right) \cdot b \cdot d1 = 1482.624\ kN$$

Vmax>V1 & V2 therefore, OK

Eq 6.5- Vuc - Shear Resistance more than 3D from support

Not Applicable

Depth Factor ξs $\quad \xi s := \left(\frac{500}{d1}\right)^{0.25}$ $\quad \xi s := 1.173$ but not less than 0.7

Ratio of longitudinal reinforcement ρs $\quad \rho s := \left(\frac{100 \cdot As1}{b \cdot d1}\right) = 0.428$ but not less than 0.15 or greater than 3

Eq 6.5 $\quad Vuc := \frac{0.27}{\gamma mvuls} \cdot \xi s \cdot \rho s^{\frac{1}{3}} \cdot fcu^{\frac{1}{3}} \cdot b \cdot d1$ $\quad Vuc := 179.3\ kN$
Vuc>V2 therefore, OK

Eq 5.6c - Vu - Shear Resistance within 3D from support

@d from support

Section 9 - for calculating the anchorage bond strength and anchorage resistance

$k := 1$ normal concrete
$\beta := 0.7$ Type 2 deformed bars in tension - table 9.1 - CS 455

$acon := 0.4$ for bars or strands NOT enclosed by links
$c := 30\ mm$ cover to rebar
$\phi := 12\ mm$ bar diameter

$av := d1 = 264\ mm$
$la := av - c = 234\ mm$ effective anchorage length

$$kcov := acon \cdot \left(0.5 + \frac{c}{\phi}\right) = 1.2$$

$$p := \pi \cdot \phi = 37.699\ mm$$

Eq 9.1b Average anchorage bond strength $\quad fub := \frac{\left(k \cdot kcov \cdot \beta \cdot \sqrt{fcu}\right)}{\gamma mbuls}$ $\quad fub := 4.025\ \frac{N}{mm^2}$

Eq 9.1a Anchorage resistance

$$Fub := fub \cdot p \cdot la = 35.507\ kN$$

but not greater than $$Fubmax := \frac{(As1 \cdot fy)}{\gamma msuls} = 403.226\ kN$$

Eq 5.6c Shear Resistance within 3D from support => Vu= Max. of Vu1 and Vu2

$$Vu1 := \frac{3 \cdot d1}{av} \cdot \Gamma \cdot Vuc$$

$$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d1$$

Eq 5.6d Factor to account for the effect of short anchorage lengths => Γ = Min. of $\Gamma1$ and $\Gamma2$

$$\Gamma1 := \sqrt{\left(\frac{z}{3 \cdot d1} \cdot \frac{Fub}{Vuc}\right)} = 0.253$$

$$\Gamma2 := 1.0$$

$$\Gamma := min(\Gamma1, \Gamma2) = 0.253$$

Eq 5.6c - Vu2

$$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d1 \qquad Vu2 := 112.37\ kN$$

Eq 5.6c - Vu1

@d from support

$$Vu1 := \frac{3 \cdot d1}{av} \Gamma \cdot Vuc = 135.97\ kN$$

Vu1>Vu2, Therefore, Vu=Vu1

Vu>V1, Therefore, Shear is acceptable at d from support

@3d from support

Section 9 - for calculating the anchorage bond strength and anchorage resistance

$k := 1$ normal concrete
$\beta := 0.7$ Type 2 deformed bars in tension - table 9.1 - CS 455

$acon := 0.4$ for bars or strands NOT enclosed by links
$c := 30\ mm$ cover to rebar
$\phi := 12\ mm$ bar diameter

$av := 760\ mm$ midspan
$la := av = 760\ mm$ effective anchorage length

$$kcov := acon \cdot \left(0.5 + \frac{c}{\phi}\right) = 1.2$$

$$p := \pi \cdot \phi = 37.699\ mm$$

Eq 9.1b Average anchorage bond strength

$$fub := \frac{(k \cdot kcov \cdot \beta \cdot \sqrt{fcu})}{\gamma mbuls} \qquad fub := 4.025 \frac{N}{mm^2}$$

Eq 9.1a Anchorage resistance

$$Fub := fub \cdot p \cdot la = 115.322\ kN$$

but not greater than $Fubmax := \frac{(As1 \cdot fy)}{\gamma msuls} = 403.226\ kN$

Eq 5.6c Shear Resistance within 3D from support => Vu= Max. of Vu1 and Vu2

$$Vu1 := \frac{3 \cdot d1}{av} \cdot \Gamma \cdot Vuc$$

$$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d1$$

Eq 5.6d Factor to account for the effect of short anchorage lengths => Γ = Min. of $\Gamma 1$ and $\Gamma 2$

$$\Gamma 1 := \sqrt{\left(\frac{z}{3 \cdot d1} \cdot \frac{Fub}{Vuc}\right)} = 0.456$$

$$\Gamma 2 := 1.0$$

$$\Gamma := \min(\Gamma 1, \Gamma 2) = 0.456$$

Eq 5.6c - Vu2

$$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d1 \qquad Vu2 := 112.37\ kN$$

Eq 5.6c - Vu1

@3d from support

$$Vu1 := \frac{3 \cdot d1}{av} \Gamma \cdot Vuc = 85.12\ kN$$

Vu1>Vu2, Therefore, Vu=Vu1

Vu>V2, Therefore, Shear is acceptable at 3d from support

Vmax is greater than V anywhere on the beam,
Vuc is greater than V beyond D from support and
Vu is greater than V within 3D from support,
Therefore ULS Shear Capacity is acceptable

WALLACE STONE	Project : TOWN BRIDGE	
Calculation Sheet	Job No. : 2405	Made By : RS
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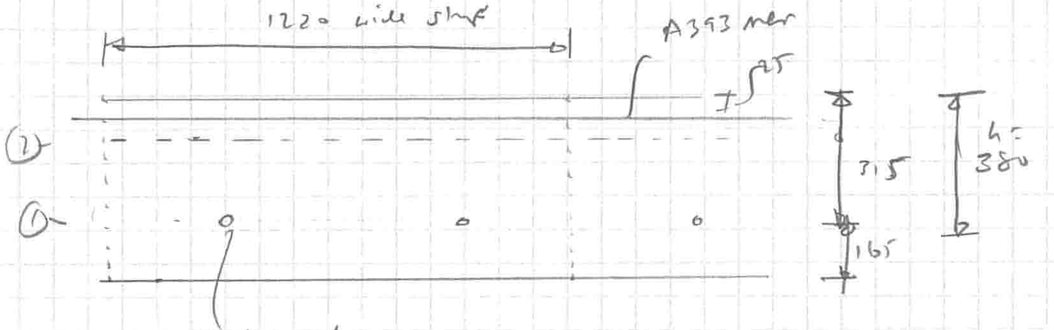
Output

Capacity

Transverse deck slab between TY beams



concrete grade 45/20 ∴ $f_{cu} = 45 N/mm^2$

High yield ribbed rebar (1975) ∴ $f_y = 410 N/mm^2$

layer (1.) = $2 \times \pi \times 20^2 = 2513.3 mm^2$ d = 315 mm

layer (2) = $393 mm^2$ $\times 1.22 = 479.5 mm^2$ d = 25 + 5 = 30 mm

See SAND/SCALE PRINT OUT OVER

ULS Sag moment

MR = 263.83 kN.m / 1.22 m wide strip
= 216.25 kNm/m > 38.45 kNm/m   UR = 0.18

Hog moment

MR = 57.65 kN.m / 1.22 m wide strip
= 47.250 kNm/m > 34.47 kN.m/m   UR = 0.73

Shear

Vmax = 2158.23 kN / 1.22 m wide strip
= 1769 kN/m. > 105.2 kN/m

Vuc = 247.61 kN / 1.22 m wide strip

= 202.96 kN/m > 105.2 kN/m   UR = 0.52

Location: Transverse Spanning Slab between T1 Beams

Partial Factors for Materials - See Table 2.13 of CS 455

ULS - Table 2.13a

Reinforcement and Prestress Tendons - not 460 grade - Characteristic Strength $\gamma msuls := 1.15$

Concrete - Characteristic Strength $\gamma mculs := 1.5$

Shear in Concrete - Characteristic Strength $\gamma mvuls := 1.25$

Bond in Concrete - Characteristic Strength $\gamma mbuls := 1.4$

Moment resistance of Reinforced Slabs at ULS - Section 6 - CS 455

Deck slab modelled as one way spanning in ROBOT grillage Model orthogonal to the transverse reinforcement. Longitudinal bending assumed taken by precast beams. In accordance with clause 6.1 the one way spanning slab moment capacity shall be calculated using the same assumptions for reinforced concrete beams

Max ULS Bending Moment (M) from the ROBOT Model in the

$Msag := 46.91\ kN \cdot m$ per 1.22 metre wide strip

$Mhog := 42.05\ kN \cdot m$ per 1.22 metre wide strip

Characteristic concrete Strength, $fcu := 45 \dfrac{N}{mm^2}$

Characteristic steel Strength, $fy := 410 \dfrac{N}{mm^2}$

width of section in compression at n.a $b := 1220\ mm$

Sagging Moment Capacity

Assume singular layer of reinforcement as top layer will be restraining the hogging moments over the supports

Area of bottom reinforcement $As1 := 2513.3\ mm^2$

effective depth of tension rebar from extreme comp. fibre $d1 := 315\ mm$

Eq 5.2.2b Lever Arm for beams without compression reinforcement

$$z := \left(1 - \frac{\left(0.84 \cdot \frac{(fy \cdot As1)}{\gamma msuls}\right)}{\frac{(fcu \cdot b \cdot d1)}{\gamma mculs}}\right) \cdot d1 = 294.435\ mm$$

$0.95\ d1 = 299.25\ mm$ z<0.95d, therefore OK

$z := 294.435\ mm$

Eq 5.2.2a Moment Resistance for beams without compression reinforcement => Mu= Min. of Mu1 and Mu2

$$Mu1 := \left(\frac{fy}{\gamma msuls}\right) \cdot As1 \cdot z = 263.827\ kN \cdot m$$

per 1.22 metre wide strip

$$Mu2 := \left(\frac{0.225 \cdot fcu}{\gamma mculs}\right) \cdot b \cdot d1^2 = 817.118\ kN \cdot m$$

per 1.22 metre wide strip

Therefore, $Mu := min(Mu1, Mu2) = 263.827\ kN \cdot m$

per 1.22 metre wide strip

Msag<Mu, therefore OK for single reinforced section

<u>Hogging Moment Capacity</u>

Assume singular layer of reinforcement as bottom layer will be restraining the sagging moments over the supports

Area of bottom reinforcement $As2 := 479.5\ mm^2$ effective depth of tension rebar from extreme comp. fibre $d2 := 355\ mm$

Eq 5.2.2b Lever Arm for beams without compression reinforcement

$$z := \left(1 - \frac{\left(0.84 \cdot \frac{(fy \cdot As2)}{\gamma msuls}\right)}{\frac{(fcu \cdot b \cdot d2)}{\gamma mculs}}\right) \cdot d2 = 351.077\ mm$$

$0.95\ d2 = 337.25\ mm$ z<0.95d, therefore not OK

$z := 337.25\ mm$

Eq 5.2.2a Moment Resistance for beams without compression reinforcement => Mu= Min. of Mu1 and Mu2

$$Mu1 := \left(\frac{fy}{\gamma msuls}\right) \cdot As2 \cdot z = 57.654\ kN \cdot m$$

per 1.22 metre wide strip

$$Mu2 := \left(\frac{0.225 \cdot fcu}{\gamma mculs}\right) \cdot b \cdot d2^2 = 1037.816\ kN \cdot m$$

per 1.22 metre wide strip

Therefore, $Mu := min(Mu1, Mu2) = 57.654\ kN \cdot m$

per 1.22 metre wide strip

Mhog<Mu, therefore OK for single reinforced section

Shear resistance of reinforced slabs at ULS - Section 5 - CS 455

Shear resistance in slabs as per cl 6.5 of CS 455. Shear resistance to be calculated as per section 5 (beams) except for Vuc more than 3D from support. However, span is short and all of slab within 3D from support.

Max ULS Shear Force (V) from the ROBOT Model

$V1 := 128.34\ kN$ per 1.22 metre wide strip at support

$V2 := \blacksquare$ N/A per 1.22 metre wide strip beyond 3D from support

cl 5.6 of CS 455 - Shear force V from Robot Model cannot exceed Vmax anywhere, Vuc more than 3D from support and Vu within 3D from support

Eq 5.6a - Vmax - Max Shear Based on concrete crushing

$$Vmax := 0.36 \cdot \left(0.7 - \left(\frac{fcu}{250 \frac{N}{mm^2}}\right)\right) \cdot \left(\frac{fcu}{\gamma mculs}\right) \cdot b \cdot d1 = 2158.229 \; kN$$

Vmax>V1 & V2 therefore, OK

Eq 6.5- Vuc - Shear Resistance more than 3D from support

Not Applicable

Depth Factor ξs $\xi s := \left(\frac{500}{d1}\right)^{0.25}$ $\xi s := 1.122$ but not less than 0.7

Ratio of longitudinal reinforcement ρs $\rho s := \left(\frac{100 \cdot As1}{b \cdot d1}\right) = 0.654$ but not less than 0.15 or greater than 3

Eq 6.5 $Vuc := \frac{0.27}{\gamma mvuls} \cdot \xi s \cdot \rho s^{\frac{1}{3}} \cdot fcu^{\frac{1}{3}} \cdot b \cdot d1$ $Vuc := 287.55 \; kN$ per 1.22 metre wide strip at support

Vuc>V2 therefore, OK

Eq 5.6c - Vu - Shear Resistance within 3D from support

@d from support

Section 9 - for calculating the anchorage bond strength and anchorage resistance

$k := 1$ normal concrete

$\beta := 0.7$ Type 2 deformed bars in tension - table 9.1 - CS 455

$acon := 0.4$ for bars or strands NOT enclosed by links

$c := 30 \; mm$ cover to rebar

$\phi := 40 \; mm$ bar diameter

$av := d1 = 315 \; mm$

$la := av = 315 \; mm$ effective anchorage length

$$kcov := acon \cdot \left(0.5 + \frac{c}{\phi}\right) = 0.5$$

$$p := \pi \cdot \phi = 125.664 \; mm$$

Eq 9.1b Average anchorage bond strength $fub := \frac{\left(k \cdot kcov \cdot \beta \cdot \sqrt{fcu}\right)}{\gamma mbuls}$ $fub := 1.677 \frac{N}{mm^2}$

Eq 9.1a Anchorage resistance $Fub := fub \cdot p \cdot la = 66.382\ kN$

but not greater than $Fubmax := \frac{(As1 \cdot fy)}{\gamma msuls} = 896.046\ kN$

Eq 5.6c Shear Resistance within 3D from support => Vu= Max. of Vu1 and Vu2

$$Vu1 := \frac{3 \cdot d1}{av} \cdot \Gamma \cdot Vuc$$

$$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d1$$

Eq 5.6d Factor to account for the effect of short anchorage lengths => Γ = Min. of $\Gamma1$ and $\Gamma2$

$$\Gamma1 := \sqrt{\left(\frac{z}{3 \cdot d1} \cdot \frac{Fub}{Vuc}\right)} = 0.287$$

$$\Gamma2 := 1.0$$

$$\Gamma := min(\Gamma1, \Gamma2) = 0.287$$

Eq 5.6c - Vu2

$$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d1$$

$Vu2 := 156.46\ kN$ per 1.22 metre wide strip at support

Eq 5.6c - Vu1

@d from support

$$Vu1 := \frac{3 \cdot d1}{av} \Gamma \cdot Vuc = 247.608\ kN$$

per 1.22 metre wide strip at support

Vu1>Vu2, Therefore, Vu=Vu1

Vu>V1, Therefore, Shear is acceptable at d from support

Vmax is greater than V anywhere on the beam,
Vuc is greater than V beyond D from support and
Vu is greater than V within 3D from support,
Therefore ULS Shear Capacity is acceptable

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Calculation Sheet	Job No. : 2405	Made By : RS
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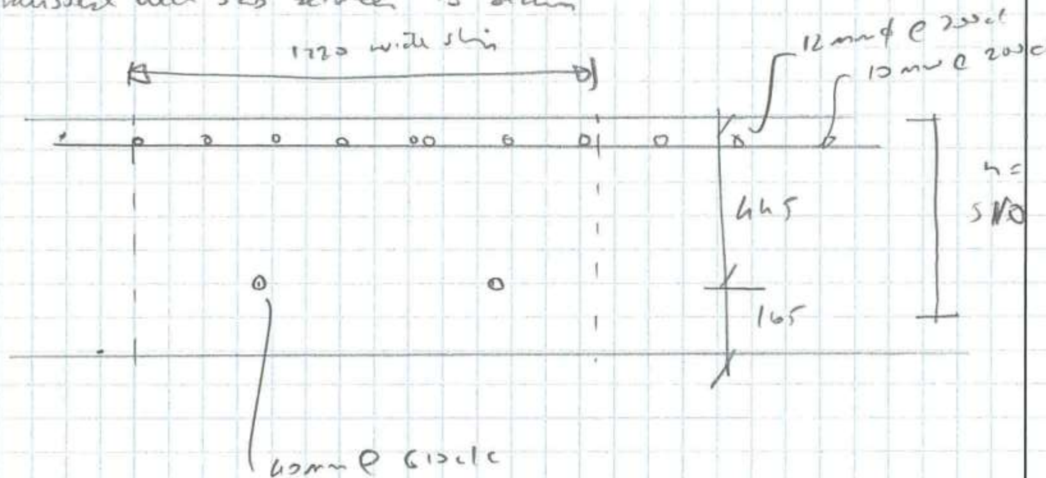
Output

Capacity

Transverse deck slab between T3 Beams



Concrete grade C45/55 f_{cu} = 45 N/mm²

High yield ribbed rebar f_y = 410 N/mm²

layer (1) = $2 \times \pi \times 20^2$ = 2513.3 mm² d = 445 mm

layer (2) = $6 \times \pi \times 6^2$ = 678.6 mm² d = 25 + 6 = 31 mm

see calculations over

ULS

SAG = 378.8 kN.m / 1.22 m wide strip
= 310.5 kN.m/m > 17.29 kN.m/m UR = 0.06

HOG = 110.09 kN.m / 1.22 m wide strip
= 90.24 kN.m/m > 34.47 kN.m/m UR = 0.38

Shear

Vmax = 3048.93 kN / 1.22 m wide strip
= 2499.1 kN/m > 52.48 kN/m

Vuc = 309.22 kN / 1.22 m wide strip
= 253.5 kN/m > 52.48 kN/m

UR = 0.21

Location: Transverse Spanning Slab between T3 Beams

Partial Factors for Materials - See Table 2.13 of CS 455

ULS - Table 2.13a

Reinforcement and Prestress Tendons - not 460 grade - Characteristic Strength $\gamma msuls := 1.15$

Concrete - Characteristic Strength $\gamma mculs := 1.5$

Shear in Concrete - Characteristic Strength $\gamma mvuls := 1.25$

Bond in Concrete - Characteristic Strength $\gamma mbuls := 1.4$

Moment resistance of Reinforced Slabs at ULS - Section 6 - CS 455

Deck slab modelled as one way spanning in ROBOT grillage Model orthogonal to the transverse reinforcement. Longitudinal bending assumed taken by precast beams. In accordance with clause 6.1 the one way spanning slab moment capacity shall be calculated using the same assumptions for reinforced concrete beams

Max ULS Bending Moment (M) from the ROBOT Model in the

$Msag := 21.09\ kN \cdot m$ per 1.22 metre wide strip

$Mhog := 42.05\ kN \cdot m$ per 1.22 metre wide strip

Characteristic concrete Strength, $fcu := 45 \dfrac{N}{mm^2}$

Characteristic steel Strength, $fy := 410 \dfrac{N}{mm^2}$

width of section in compression at n.a $b := 1220\ mm$

Sagging Moment Capacity

Assume singular layer of reinforcement as top layer will be restraining the hogging moments over the supports

Area of bottom reinforcement $As1 := 2513.3\ mm^2$

effective depth of tension rebar from extreme comp. fibre $d1 := 445\ mm$

Eq 5.2.2b Lever Arm for beams without compression reinforcement

$$z := \left(1 - \frac{\left(0.84 \cdot \dfrac{(fy \cdot As1)}{\gamma msuls}\right)}{\dfrac{(fcu \cdot b \cdot d1)}{\gamma mculs}}\right) \cdot d1 = 424.435\ mm$$

$0.95\ d1 = 422.75\ mm$ z>0.95d, therefore NOT OK

$z := 422.75\ mm$

Eq 5.2.2a Moment Resistance for beams without compression reinforcement => Mu= Min. of Mu1 and Mu2

$$Mu1 := \left(\frac{fy}{\gamma msuls}\right) \cdot As1 \cdot z = 378.803\ kN \cdot m$$

per 1.22 metre wide strip

$Mu2 := \left(\frac{0.225 \cdot fcu}{\gamma mculs}\right) \cdot b \cdot d1^2 = 1630.736\ kN \cdot m$ per 1.22 metre wide strip

Therefore, $Mu := min(Mu1, Mu2) = 378.803\ kN \cdot m$ per 1.22 metre wide strip

Msag<Mu, therefore OK for single reinforced section

<u>Hogging Moment Capacity</u>

Assume singular layer of reinforcement as bottom layer will be restraining the sagging moments over the supports

Area of bottom reinforcement $As2 := 678.6\ mm^2$ effective depth of tension rebar from extreme comp. fibre $d2 := 479\ mm$

Eq 5.2.2b Lever Arm for beams without compression reinforcement

$$z := \left(1 - \frac{\left(0.84 \cdot \frac{(fy \cdot As2)}{\gamma msuls}\right)}{\frac{(fcu \cdot b \cdot d2)}{\gamma mculs}}\right) \cdot d2 = 473.447\ mm$$

$0.95\ d2 = 455.05\ mm$ z<0.95d, therefore not OK

$z := 455.05\ mm$

Eq 5.2.2a Moment Resistance for beams without compression reinforcement => Mu= Min. of Mu1 and Mu2

$Mu1 := \left(\frac{fy}{\gamma msuls}\right) \cdot As2 \cdot z = 110.093\ kN \cdot m$ per 1.22 metre wide strip

$Mu2 := \left(\frac{0.225 \cdot fcu}{\gamma mculs}\right) \cdot b \cdot d2^2 = 1889.447\ kN \cdot m$ per 1.22 metre wide strip

Therefore, $Mu := min(Mu1, Mu2) = 110.093\ kN \cdot m$ per 1.22 metre wide strip

Mhog<Mu, therefore OK for single reinforced section

Shear resistance of reinforced slabs at ULS - Section 5 - CS 455

Shear resistance in slabs as per cl 6.5 of CS 455. Shear resistance to be calculated as per section 5 (beams) except for Vuc more than 3D from support. However, span is short and all of slab within 3D from support.

Max ULS Shear Force (V) from the ROBOT Model $V1 := 64.03\ kN$ per 1.22 metre wide strip at support

$V2 :=$ ▯ N/A per 1.22 metre wide strip beyond 3D from support

cl 5.6 of CS 455 - Shear force V from Robot Model cannot exceed Vmax anywhere, Vuc more than 3D from support and Vu within 3D from support

Eq 5.6a - Vmax - Max Shear Based on concrete crushing

$$Vmax := 0.36 \cdot \left(0.7 - \left(\frac{fcu}{250 \frac{N}{mm^2}}\right)\right) \cdot \left(\frac{fcu}{\gamma mculs}\right) \cdot b \cdot d1 = 3048.926\ kN$$

Vmax>V1 & V2 therefore, OK

Eq 6.5- Vuc - Shear Resistance more than 3D from support

Not Applicable

Depth Factor ξs $\quad \xi s := \left(\frac{500}{d1}\right)^{0.25}$ $\quad \xi s := 1.03$ but not less than 0.7

Ratio of longitudinal reinforcement ρs $\quad \rho s := \left(\frac{100 \cdot As1}{b \cdot d1}\right) = 0.463$ but not less than 0.15 or greater than 3

Eq 6.5 $\quad Vuc := \frac{0.27}{\gamma mvuls} \cdot \xi s \cdot \rho s^{\frac{1}{3}} \cdot fcu^{\frac{1}{3}} \cdot b \cdot d1$ $\quad Vuc := 332.36\ kN$ per 1.22 metre wide strip at support

Vuc>V2 therefore, OK

Eq 5.6c - Vu - Shear Resistance within 3D from support

@d from support

Section 9 - for calculating the anchorage bond strength and anchorage resistance

$k := 1$ normal concrete
$\beta := 0.7$ Type 2 deformed bars in tension - table 9.1 - CS 455

$acon := 0.4$ for bars or strands NOT enclosed by links
$c := 30\ mm$ cover to rebar
$\phi := 40\ mm$ bar diameter

$av := d1 = 445\ mm$
$la := av = 445\ mm$ effective anchorage length

$$kcov := acon \cdot \left(0.5 + \frac{c}{\phi}\right) = 0.5$$

$$p := \pi \cdot \phi = 125.664\ mm$$

Eq 9.1b Average anchorage bond strength $\quad fub := \frac{\left(k \cdot kcov \cdot \beta \cdot \sqrt{fcu}\right)}{\gamma mbuls}$ $\quad fub := 1.677\ \frac{N}{mm^2}$

Eq 9.1a Anchorage resistance

$$Fub := fub \cdot p \cdot la = 93.778\ kN$$

but not greater than $Fubmax := \frac{(As1 \cdot fy)}{\gamma msuls} = 896.046\ kN$

Eq 5.6c Shear Resistance within 3D from support => Vu= Max. of Vu1 and Vu2

$$Vu1 := \frac{3 \cdot d1}{av} \cdot \Gamma \cdot Vuc$$

$$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d1$$

Eq 5.6d Factor to account for the effect of short anchorage lengths => Γ = Min. of $\Gamma 1$ and $\Gamma 2$

$$\Gamma 1 := \sqrt{\left(\frac{z}{3 \cdot d1} \cdot \frac{Fub}{Vuc}\right)} = 0.31$$

$$\Gamma 2 := 1.0$$

$$\Gamma := min(\Gamma 1, \Gamma 2) = 0.31$$

Eq 5.6c - Vu2

$$Vu2 := \frac{0.24}{\gamma mvuls} \cdot \xi s \cdot (0.15 \cdot fcu)^{\frac{1}{3}} \cdot b \cdot d1$$

$Vu2 := 202.9\ kN$ per 1.22 metre wide strip at support

Eq 5.6c - Vu1

@d from support

$$Vu1 := \frac{3 \cdot d1}{av} \Gamma \cdot Vuc = 309.219\ kN$$

per 1.22 metre wide strip at support

Vu1>Vu2, Therefore, Vu=Vu1

Vu>V1, Therefore, Shear is acceptable at d from support

Vmax is greater than V anywhere on the beam,
Vuc is greater than V beyond D from support and
Vu is greater than V within 3D from support,
Therefore ULS Shear Capacity is acceptable

2405 - Town Bridge

Element	Effect	Factored AIL Load Effect		Factored Dead & SDL Loads Effect		Factored associated HA Load Effect		Total Factored Assessment Load Effect		Assessment Resistance		Structural Adequacy Factor	Reserve Factor against a SV Load with associated HA	Reserve Factor against a SV Load without associated HA
		S^*		S^*_D		S^*_{HA}		S^*_A		R^*_A		R^*_A/S^*_A	Ψ_{SV}	Ψ^*_{SV}
T1 Beams	ULS Max Moment midspan	84.10	kNm	82.77	kNm	35.29	kNm	202.16	kNm	473.71	kNm	2.34	3.27	4.23
	ULS Max Shear at support	86.09	kN	44.88	kN	6.29	kN	137.26	kN	151.82	kN	1.11	1.16	1.17
T3 Beams	ULS Max Moment midspan	138.12	kNm	170.75	kNm	26.04	kNm	334.91	kNm	765.34	kNm	2.29	3.62	4.12
	ULS Max Shear at support	87.20	kN	78.91	kN	17.75	kN	183.86	kN	187.35	kN	1.02	1.03	1.04
Parapet Edge Beams	ULS Max Moment midspan	112.80	kNm	301.11	kNm	13.66	kNm	427.56	kNm	1073.4	kNm	2.51	6.11	6.73
	ULS Max Shear at support	26.23	kN	169.84	kN	0.57	kN	196.64	kN	1670.99	kN	8.50	56.00	57.20
	ULS Max Shear at 3d from support	28.48	kN	81.18	kN	1.62	kN	111.28	kN	207.32	kN	1.86	4.19	4.37
Transverse Footway Slab	ULS Max Moment midspan (sag)	10.75	kNm/m	13.92	kNm/m	1.90	kNm/m	26.56	kNm/m	101.13	kNm/m	3.81	6.90	7.94
	ULS Max Moment support (hog)	6.04	kNm/m	14.55	kNm/m	1.50	kNm/m	22.08	kNm/m	51.52	kNm/m	2.33	4.91	5.88
	ULS Max Shear at support	12.55	kN/m	29.49	kN/m	2.47	kN/m	44.51	kN/m	112.37	kN/m	2.52	5.52	6.41
Slab Between T1 Beams	ULS Max Moment midspan (sag)	34.33	kNm/m	2.59	kNm/m	1.53	kNm/m	38.45	kNm/m	216.25	kNm/m	5.62	5.96	6.18
	ULS Max Moment support (hog)	14.64	kNm/m	12.65	kNm/m	7.18	kNm/m	34.47	kNm/m	47.25	kNm/m	1.37	1.59	1.87
	ULS Max Shear at support	78.23	kN/m	18.31	kN/m	8.67	kN/m	105.20	kN/m	202.96	kN/m	1.93	2.13	2.25
Slab Between T3 Beams	ULS Max Moment midspan (sag)	13.04	kNm/m	2.68	kNm/m	1.57	kNm/m	17.29	kNm/m	310.5	kNm/m	17.96	21.07	23.48
	ULS Max Moment support (hog)	18.59	kNm/m	10.68	kNm/m	4.78	kNm/m	34.05	kNm/m	90.24	kNm/m	2.65	3.40	4.02
	ULS Max Shear at support	21.00	kN/m	30.77	kN/m	0.72	kN/m	52.48	kN/m	253.5	kN/m	4.83	10.26	10.57

* Shear Resistance does not include capacity from shear reinforcement.

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