1.0 Assumptions

1.1 Set-out of the tripods and the Cradle are based on the cut sections of the Blade provided by Siemens within file 'B75 SectionCut.stp'.

1.2 Siemens wind loading spreadsheet (file: 'Aerodynamic Blade Loading in Storage Configuration. Blade B75-00 K') has been used to calculate the wind loads acting along the length of the Blade. Siemens are to underwrite this spreadsheet. A gust wind speed of 26 m/s has been used to calculate a gust pressure in accordance with EN 1991.

1.3 The dead weight of the Blade has been obtained from Siemens tandem lift drawing 'JW-WS-LB-001' and the distribution of weight on each tripod for the support conditions has been calculated through interpolation of the lifting loads on this drawing.

1.4 The Blade profile along its length and its centre of gravity has been obtained from Siemens drawing 'D1019598'.

1.5 Siemens are to satisfy themselves that the stresses developed within the Blade under the design loads and support conditions are within the capacity of the Blade. Particular consideration is to be given to the support details provided at the tip tripod by the cradle; including the support points and details. As agreed with Siemens the centre of the uppermost lateral support is positioned at 425mm from the trailing edge, in order to align with a stiffened point within the Blade.

1.6 Siemens to confirm that the fabricated plate shoes are suitable to support the Blade at an angle of 4 degrees to the horizontal.

1.7 The deflection of the Blade under design loads has been calculated using stiffness data provided by Siemens.

2.0 Steelwork

2.1 For set out of the Blade and the tripod supports refer to Arup Public Realm drawing.

2.2 All levels to be verified on site.

2.3 All steelwork is to be fabricated in accordance with Execution Class 2.

2.4 All steelwork to be hot rolled S355 JO.

2.5 All bolts to be M20 Grade 8.8. Except where Tension Control Bolts are specified.

2.6 Bolted steelwork connections shall not comprise less than 4 No. M20 Grade 8.8 bolts unless approved by Arup.

2.7 Stiffeners should be provided as shown on the drawings.

2.8 Non shrink grout is to be provided beneath the full area of the baseplate (approx. 20mm depth)

2.9 All steel products for use in The Works shall have been specifically tested in accordance with the appropriate product standard. The steel product manufacturer shall declare the results using an inspection certificate type 3.1 to BS EN 10204. *Mechanical test results in place of a type 3.1 certificate from the manufacturer are not acceptable for production steel or for steel used in welding procedures.*

2.10 The steelwork contractor shall obtain the manufacturer's test certificate for the finished product and make it available to the Engineer or Inspection Authority. Steel that is supplied as ingot or slab and subsequently rolled will require additional testing, to be confirmed by the Engineer.

2.11 All materials, fabrication, workmanship and erection of steelwork shall be in accordance with the 5th edition of the NSSS CE marking.

2.12 All materials to harmonised European Standards (e.g. BS EN 10025) shall be CE marked.

2.13 Joints shall be fitted up to the dimensional accuracy required by the welding procedure, depending on the process used, to ensure that the quality in Table C.1 and C.2 in Annex C of the National Structural Steelwork Specification, CE Marking Edition is satisfied.

3.0 Welding

3.1 CHS to CHS connections to be full strength welded connections. Welds to achieve full local capacity of the section. Full penetration butt welds or similar.

3.2 Refer to typical details for weld requirements. No welds to be less than 6mm CFW.

3.3 Where any full strength weld consists of a partial penetration butt weld and superimposed fillet the component specification shall clearly show the dimensions of the nominated un-fused land within the weld to enable sizing by ultrasonic inspection.

3.4 Welding shall be a metal arc process in accordance with BS EN 1011-1 and BS EN 1011-2 as appropriate, together with clauses contained in this section.

3.5 The Steelwork Contractor's system for the management of welding shall meet the standard quality requirements as described in BS EN 3834-3.

3.6 *Note: As a minimum, this requires that welding coordination is undertaken by persons with technical knowledge as that described in BS EN ISO 3834-5 (Certified International Welding Engineer, IWE).*

3.7 All welding documentation (welder qualifications, welding procedure qualification records, welding procedure specifications and associated work instructions) shall be reviewed for applicability by the person responsible for welding coordination.

3.8 Joints shall be prepared in accordance with BS EN ISO 9692, parts 1 and 2. Consideration should be taken when preparing hollow sections to Annex E, BS EN 1090-2. Precautions shall be taken to ensure cleanliness of the connection prior to welding.

3.9 Welders shall be tested to meet the requirements of EN 287.

3.10 Welder approvals shall have been witnessed and approved by an Examiner/Examining Body who shall be an independent body accredited by UKAS (ISO 9001).

3.11 As required in EN 287, welders shall be tested within 2 years of the previous test (ultrasonic, radiographic) and the report kept with the welder's approval sheet. The welder shall be subject to re-test every 4 years.

3.12 Welders shall work within the stipulated limitations as given in EN 287 at all times.

3.13 Welding procedure trials shall be welded using the same premises, equipment, consumables and operatives as planned will be used in construction. They shall be witnessed and approved by an Examiner/Examining Body (EEB). The EEB shall be approved by the Engineer prior to appointment. The EEB shall be furnished with all relevant contract documentation and the project specification. It should be noted that the EEB is independent and shall provide information as requested by the Main Contractor or Engineer without recourse to the fabricator. This is to be confirmed in writing by the EEB.

3.14 Witnessing of procedures shall be undertaken by approved inspectors employed by the EEB. Inspectors shall be approved (PCN, EN 473) and approval of welding procedures and welding procedure specifications shall be by an approved IWT, to EN 15614 as a minimum. Consideration should be made of weld connections of non-standard types that will require approval to BS EN 15613. Particular attention is required for welding procedures used for the welding of hollow sections. This should address both hot (EN 10210) or cold (EN 10219) formed method of manufacture. Connection design places particular requirements on welding procedures for hollow sections and the requirements shown in BS EN 1090, Annex E should be met.

3.15 Approvals may be previously qualified and/or approved to EN 288 if equivalent to EN 15614, EN 15613, EN 15614, table 1, has specified tests that have to be conducted to approve the welding procedure. If both hardness tests and impact (charpy) tests are specified then impact tests shall be taken from highest impact position and hardness tests from the lowest heat input position to qualify all positions. In addition to the requirements of Table 1 all welding procedures shall have a hardness survey as a minimum.

3.0 Welding (continued)

3.16 Documents required to support a welding procedure qualification record are as follows:
WPQR
- Full record of all welding parameters, run times and any breaks in welding. Summary information is not acceptable
- Preheat, maintenance and interpass temperatures should be recorded, ambient is not acceptable.
- Complete mechanical test results
- Complete non-destructive test results
- Copy of the original material certificates (which should have either a full chemical analysis or the carbon equivalent)
- Consumable certificates (if available)

Summary documents are not acceptable. All welding trials and testing shall be witnessed and endorsed by the Independent Examiner/Examining Body

3.17 Formal welding procedure specifications (WPSs) shall be available in accordance with BS EN ISO 15609-1, and tested in accordance with BS EN ISO 15614-1 or BS EN 15613 by the Steelwork Contractor. They shall comply with the guidance of BS EN 1011-2, Annex C, Method A in the avoidance of hydrogen cracking, and Annex D to provide adequate toughness in the heat affected zone of the weld (HAZ). WPS's for hollow sections shall follow guidance given in Annex E, BS EN 1090-2. Generic work instructions are not acceptable.

3.18 Full penetration butt welds including tee butts shall meet the butt weld requirements of Table 1, BS EN ISO 15614-1, unless otherwise agreed. Any weld type nominated as a full strength butt weld (FSBW) shall also meet the full requirements of Table 1, BS EN ISO 15614-1. This includes the tensile test with any un-fused land as shown in the design of the weld. In addition any change in preparation, preparation angle or type (e.g. V to a single bevel) will require re-approval.

3.19 Fillet welds are acceptable with the requirements of Table 1, BS EN ISO 15614-1, but the additional requirements given in note 5 apply when pre-qualified procedures fail to meet the requirements of BS EN ISO 15614-1, or to confirm mechanical properties (tensile strength and impact properties) of the joint.

3.20 Carbon equivalent (CE) is considered to be an essential variable and included in the other factors in Section 8.3, BS EN ISO 15614-1. A decrease in the CE (calculated according to the IIW formula) is allowable, but, unless otherwise agreed, any increase greater than 0.01% for steels with CE>0.40% will require an additional test piece.

3.21 Toughness is to be considered to be an essential variable and included in the other factors in Section 8.3, BS EN ISO 15614-1. The toughness of the weld metal, the Heat Affected Zone and the parent metal shall be shown on the approval record. Where this shows a reduction in material toughness compared to that of the supplied parent material, that reduction shall be subtracted from the project material to be welded. If the resultant toughness falls below the design requirements, unless otherwise agreed, the procedure shall be approved on project material.

Note: This requires Charpy testing on weld metal, HAZ and parent metal, this is an additional requirement to EN 15614.

3.22 The maximum hardness shown in the WPQR's shall be limited to 350Hv max for multipass welds and 380Hv for single pass welds. The WPS for both single pass and multipass welds at high hardness levels will be limited to the minimum heat input from the WPQR and actual carbon equivalent shown on the material certificate unless agreed otherwise by the Engineer in reference to particular welding procedure qualification records and welding procedure specifications.

3.23 The upper limit to the range of qualification shown in EN 15614, section 8.3.2.2, table 5 shall not apply. A thickness greater than that of the test piece will require a new procedure qualification.

3.24 The steel grouping shown in table 3, EN 15614 shall be amended. Group 1.1 will only apply to S275 steel and below (hardness tests are required), procedures qualified to this group will not be acceptable for S355 and higher grade specific approval tests unless otherwise agreed by the Engineer.

3.25 The type of joint/weld will be limited to that shown in the approval record.

3.26 Heat inputs shown in the approval record are acceptable within the limits shown but each type of weld run must be treated separately. This applies to root, hot pass, fill and cap. Using the lowest heat input from any type and the highest heat input from a different type to gain the widest range of heat inputs is not acceptable. Full consideration of the steel microstructure is required.

3.27 Each WPS will only be approved by a single WPQR. The use of multiple WPQR's is not acceptable.

3.28 All WPSs shall be approved by the welding coordinator (IWE) before being used in production. Where WPSs are based on previously approved WPQRs they shall be submitted to the Examiner/Examining Body for verification of compliance with this specification, EN 15614, EN 15613 and EN 1011. WPSs shall be made available to the Engineer, Employer or Inspection Authority on request.

Note: The suitability of WPSs for the steel to be welded includes the consideration of the actual carbon equivalent of the steel if t his differs from the value (CE) recorded in the WPQR.

3.29 Formal job specific WPSs shall be available to the welder or operator prior to commencement of works.

3.30 The sequence of welding a joint or a sequence of joints shall be such that distortion is controlled and minimised and specified limits not exceeded.

4.0 Non Destructive Weld Testing

4.1 Category A is the default level unless otherwise specified.

Table A Inspection

Weld Type	Category A			Category B		
	Visual	MPI	Ultrasonic	Visual	MPI	Ultrasonic
FPBW	100%	100% first 5 of weld type, then 50% thereafter.	Material thickness ≥ 8mm 100% first 5 of weld type then 50%	100%	100% first 5 weld type, then 20%.	Material thickness ≥ 8mm 100% first 5 of weld type then 20%
FSBW	100%	100% first 5 of weld type, then 50% thereafter.	Material thickness ≥ 8mm 100% first 5 of weld type then 50%	100%	100% first 5 weld type, then 20%.	Material thickness ≥ 8mm 100% first 5 of weld type then 20%
PPBW	100%	100% first 5 of weld type, then 20% thereafter.	Material thickness ≥ 8mm 100% first 5 of weld type then 50%	100%	100% first 5 weld type, then 20%.	Material thickness ≥ 8mm 100% first 5 of weld type then 10%
FW	100%	100% first 5 of weld type, then 20%, reducing to 10% of weld length to include start/stop zones.	Material thickness ≥ 8mm, leg length ≥ 12mm 100% first 5 of weld type then 10% of weld length	100%	100% first 5 of weld type, then 10%, reducing to 5% of weld length to include start/stop zones.	Not required

Note: Site welds 100% inspection.

4.0 Non Destructive Weld Testing (continued)

4.2 Inspection levels may be reduced from the stated requirement in Table A at the Engineers discretion. This will only be considered where fabricators have adequate quality control and assurance systems in place and can demonstrate a prolonged period of continuity of quality. Under such circumstances the steelwork contractor may submit alternative inspection levels for review and approval by the Engineer.

4.3 The results of visual inspection, surface flaw detection and ultrasonic inspection shall be recorded and be available when requested. All defects shall be recorded in a repair register along with remedial actions and final close-out report to verify repair. Separate records for acceptable work and defective work are not acceptable.

4.4 Visual examination shall be made in accordance with BS EN ISO 17637, sections 4 and 5 over the full length of the weld. Such inspections shall be performed before any required non-destructive inspection (to reduce time wastage) and results recorded as detailed in section 5.

4.5 A full inspection report shall be made for all inspections and shall record any defects on the same sheet as acceptable work. Fabrications and welds shall be clearly identified to enable traceability of any connections inspected. Identification of connections or welds should conform to the system adopted in the fabrication shop and should not be a separate system devised by the inspector or inspection company.

4.6 A suitably qualified person for visual inspection of welds may be a welding inspector or a welder who can provide evidence of having been trained and assessed for competence in visual inspection of the relevant types of welds during and after welding by a nationally recognised authority (TWI, PCN, CSWIP, EN 473). Internal company training schemes are not acceptable.

4.7 Magnetic particle inspection (MPI) shall be in accordance with Table A and conform to the recommendations in BS EN 17638.

4.8 If MPI is impractical, dye penetrant inspection (DPI) may be used in accordance with the recommendation given in BS EN 571-1, with the permission of the Engineer.

4.9 Final surface flaw detection of a welded joint shall be carried out after completion of the weld in accordance with the hold times given in Table C.

4.10 A full inspection report shall be made for all inspections and shall record any defects on the same report as acceptable work. Fabrications and welds shall be clearly identified to enable traceability of any connections inspected. Identification of connections or welds should conform to the system adopted in the fabrication shop and should not be a separate system devised by the inspection company.

4.11 A suitably qualified person for surface flaw detection of welds should be a welding inspector who holds a current certificate of competence from a nationally recognised authority that meets the requirements of EN 473, ISO 9712 (PCN, CSWIP).

4.12 Where ultrasonic examination is required in accordance with Table A it shall be made in accordance with EN 17640 and the following:
a. Ultrasonic inspection applies to all welds types in materials > 6mm thick, this includes full penetration butt welds, full strength butt welds, partial penetration butt welds and fillet welds with a leg length 12mm and over unless otherwise agreed by the Engineer.
b. Technique 1 or 4 as appropriate.
c. Testing level B applies unless agreed otherwise by the Engineer.
d. Straight (compression) beam probes shall be used prior to angle (shear) beam probes to verify freedom from imperfections or high attenuation.
e. Any indication > 20% DAC using angle beam probes shall be evaluated
f. All parts of section 12.5 apply including characterization.
g. No planar indications are acceptable, this includes cracks and lack of fusion.

4.13 Ultrasonic inspection shall meet as a minimum that shown in BS 3923, level 2B for scanning and sensitivity levels. Any reports submitted not stating this will not be accepted and treated as non-compliant.

4.14 Ultrasonic examination of the welded joint shall be carried out after completion of the weld in accordance with the hold times given in Table C.

4.15 A full inspection report shall be made for all inspections and shall record any defects on the same report as acceptable work. Fabrications and welds shall be clearly identified to enable traceability of any connections inspected. Identification of connections or welds should conform to the system adopted in the fabrication shop and should not be a separate system devised by the inspection company.

4.16 Inspectors carrying out ultrasonic examination shall hold a current certificate of competence from a nationally recognised authority that meets the requirements of EN 473, ISO 9712 (PCN,CSWIP).

Note: In addition to weld examination, through-thickness ultrasonic examination of the parent material may also be n ecessary for weld geometries susceptible to lamellar tearing.

4.17 Welds and adjacent material shall comply with BS EN ISO 5817, level C. For FSBW's and PPBW's the measured un-fused land shall not be a cause for rejection as long as they meet the minimum specified requirement for penetration.

4.18 All welds shall be repaired to meet the minimum requirements, a record kept and the Engineer informed of serious defects (cracks, lamellar tears, incorrect weld type/size).

4.19 If cracking or lamellar tearing is located inspection should increase to 100% for the weld type and WPS. For less serious defects inspection of previous welds should be conducted to determine if the problem is more widespread (at least 2 welds). If further defects are located increase inspection to 100% of weld type using the same WPS and inform the Engineer. Consideration should be made as to whether the defect is a procedural problem or welder induced. Repair will require a specific repair WPS which will need approval.

5.0 Protective Treatment

5.1 Protective treatment to all steelwork to be in accordance with the following;

Paint spec: Blast clean to Sa2½
Epoxy Zinc Rich to 75µm
Epoxy High Build to 150µm
Polyurethane Top Coat to 50µm (to RAL No. specified by Artist)

5.2 Any damage as a result of erection and transportation is to be made good

6.0 Outline Erection Sequence

6.1 Due consideration of temporary stability during all stages of erection is required. Contractor assumed to provide lifting eyes and bolt holes/lifting cleats as necessary.

6.2 Refer to Arup public realm drawing for the positioning of the tripods.

6.3 An erection sequence similar to the following is envisaged:-

- Tripod base set out and placed in position
- Anchors positions marked on ground through bolts holes in base plates
- Tripod removed
- Anchors drilled and grouted
- Tripod bases fixed in position
- Concrete planks/ballast placed
- Tripod upper sections erected
- Cradle fixed in position
- Blade rotated in to place
- Plated Blade shoes bolted to Blade
- Blade safely lifted into place on harness
- Blade shoes at root end bolted to tripod
- Cradle base adjusted to grip Blade at stiffener locations
- Moveable arms within Cradle positioned and clamped in place
- Crane released

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Client
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Project Title
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General Notes Drawing

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