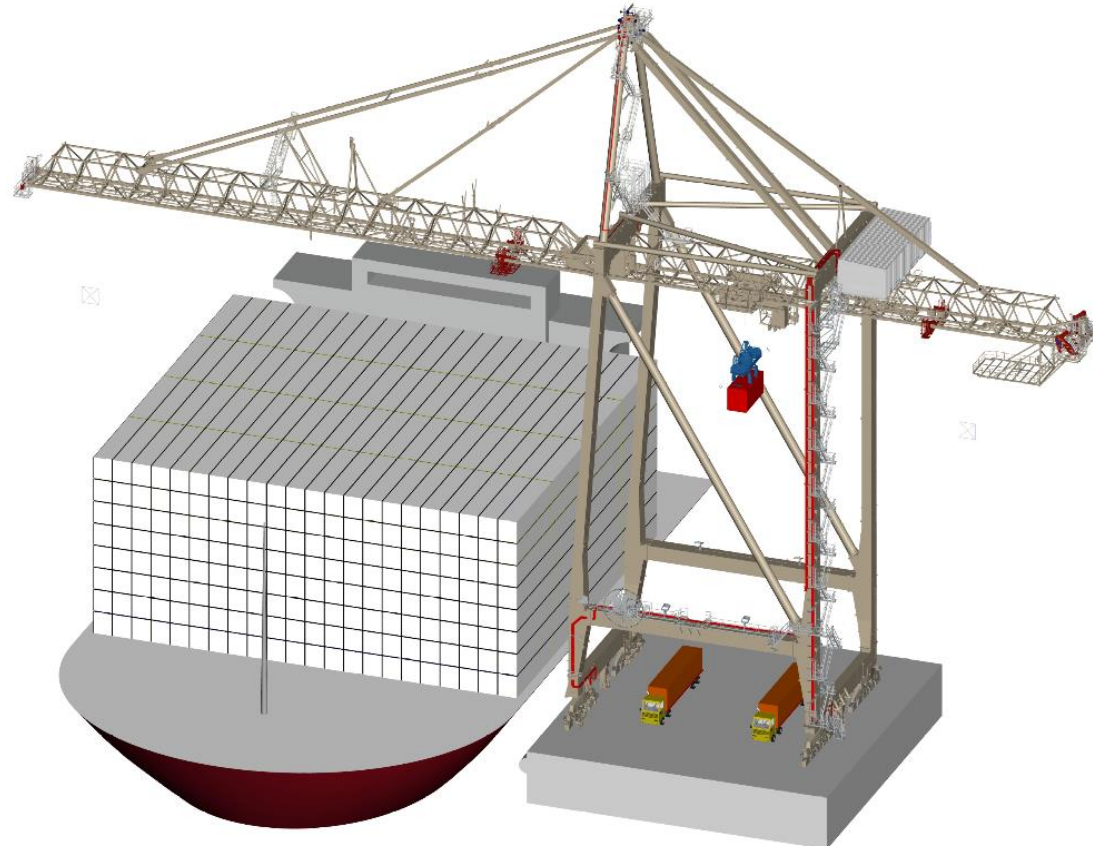


# **STRUCTURAL INSPECTION MANUAL (SIM)**

## **For Liebherr Ship to Shore Container Cranes CC2014-15, PORT OF KOPER, SLOVENIA.**



**FEBRUARY 2017**

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## **1.0 INTRODUCTION**

This document is an engineered approach to standardise crane inspections, focusing on the structurally (or fracture) critical items, based on experience of similar cranes.

The purpose of this approach is to have a framework from which to establish a Structural Inspection program regardless of crane type and integrate into the maintenance and repair regime.

This 'Structural Inspection Manual' (SIM) approach shall also ensure a 'closed loop' with respect to reporting, whereby feedback and 'early warnings' can be notified to the OEM.

## **2.0 GENERAL NOTES**

### **2.1 INSPECTIONS**

The inspections described in this manual do not over-ride local statutory requirements which in all instances must take precedence. Any inspection/s shall be carried out in accordance with locally applicable codes, i.e.: BS EN or AWE. (Please refer to Section 2 for more details).

### **2.2 PAINT REMOVAL**

Extensive paint removal is not necessary, only that necessary to view the inspected area should be removed by hand tools (wire brush etc.) or light grinding. Once inspection is complete the area should be re-painted using the same paint system as that recommended by the Crane manufacturer. If more extensive inspection is judged necessary then more paint may need to be removed to facilitate NDT examination.

### **2.3 CLEANING OF STRUCTURE**

Cleaning of the structure is critical in order to adequately view inspection areas. In particular grease or oil spills, or debris for example, beside the trolley rail, should be removed. Failure to ensure a thoroughly clean service will impede an inspector's ability to carry out an accurate visual inspection and could lead to an unwanted and unexpected incident.

### **2.4 EXAMINATIONS**

The specified examinations shall be generally visual by nature, but in any case shall be as defined in tables below. More detailed examination by NDT or other suitable methods, or closer examination using mobile access equipment, shall be used in the event any suspicious areas are identified, needing further inspection. The need for the detailed examination shall be determined by local Competent Engineering personnel.

### **2.5 INSPECTION REGIME**

The inspection regime is intended to work in parallel with the Maintenance regime, visits to particular areas should be arranged to complete both maintenance and inspection tasks.

**2.6 STRUCTURAL PINS**

Structural Pins shall be examined visually for signs of wear or distress. Bores shall be checked for wear, excessive gaps etc., externally only. Should more extensive inspection be necessary then the use of NDT methods such as Ultrasonic (UT), Eddy Current (EC) or Phased Array (PA) examination shall be employed.

**2.7 TEMPORARY ACCESS**

Some structural inspections will require the use of high level temporary access, such as mobile access platforms (“cherry pickers”) or man cages/baskets suspended from mobile cranes. In all instances where these are used the local site requirements, in terms of safety harnesses and means of communication, shall be adhered to.



### **3.0 END OF CRANE DESIGN LIFE:**

#### **3.1 LIFE EXTENSION ASSESSMENT**

For a Crane nearing the end of its designated design life, a 'Competent Engineer / Inspection Body' is to fully assess the Crane Structure and Mechanisms by whatever means necessary and appropriate, in order to advise and confirm extension of life / operating lifting cycles, that can be applied to the particular Crane.

The SIM shall be amended accordingly to reflect changes (if any) identified during the life extension assessment

#### **3.2 CRANE ASSESSMENT FOLLOWING MAJOR EVENTS:**

##### **3.2.1 MAJOR REPAIR**

Cranes should be thoroughly examined after major repairs, modifications or following extreme weather conditions. Examples of major repair or modification include:

- 3.2.1.1** Any revision to the rated capacity, travel, radius or reach
- 3.2.1.2** Structural damage due to collision with a ship, another crane etc.
- 3.2.1.3** Replacement or repair of significant structural components
- 3.2.1.4** Extreme weather conditions would include storms, typhoons or hurricanes where the maximum out of service wind speed specified by the manufacturer has been exceeded.

The competent person undertaking thorough examination may require supplementary tests and examinations to be undertaken. These may include overload testing.

### **3.3 NEGATIVE IMPACT ACTIVITIES**

This document does not take into account day to day activities that can negatively impact the integrity of a Crane, for example:

**3.3.1** A technician (whether Mech or Elec) who penetrates a 'sealed beam' structure by inadvertently drilling the structure to secure (or re-secure) a component to the sealed beam structure. This action will cause the sealed beam to be open to all elements and allow water ingress / atmospheric conditions to enter, which in turn will commence the corrosion activities with that beam.

**3.3.2** A technician (whether Mech or Elec) who inadvertently cuts an access hole (i.e.: whether through drilling or burning) to gain access for a component repair and / or replacement. This could a) possibly weaken the structure from its original design and/or b) open structure to the elements as described above in clause 3.2.1.1.

The above examples are common failures of people not trained and/or sufficiently aware of subtle actions that can change / alter the Cranes structural integrity.

### **3.4 RECORDING RESULTS**

Results shall be recorded in the format particular to the site. Engineering shall review and advise further actions; NDT examinations, repairs, effect on crane operation etc.

**3.5 ABBREVIATIONS:**

BU	Business Unit
SIM	Structural Inspection Manual
NDT	Non Destructive Testing
VT	Visual Testing
MT	Magnetic Particle Testing
EC	Eddy Current
PT	Liquid Penetrant Testing
UT	Ultrasonic Testing
PA	Phased Array
PTI	Predictive Testing & Inspection
QC	Quay Crane
FCM	Fracture Critical Member
NFCM	Non – Fracture Critical Member
EAMS	Engineering Asset Management System
OEM	Original Equipment Manufacturer (Crane)

## **4.0 TERMS AND DEFINITIONS:**

For the purposes of this SIM, the following terms and definitions apply.

### **4.1 THOROUGH EXAMINATION:**

Examination by a competent person in such depth and detail as the competent person considers necessary to enable them to determine whether the equipment being examined is safe to continue in use

**NOTE:** The thorough examination is not part of the maintenance regime for the equipment but provides owners with information which could be used to determine the effectiveness of the regime.

### **4.2 COMPETENT PERSON:**

Person who has such practical and theoretical knowledge and experience of the lifting equipment to be thoroughly examined which enables them to detect defects or weaknesses and to assess their importance in relation to the safety and continued use of the lifting equipment

### **4.3 COMPETENT ENGINEER:**

Person who has such theoretical knowledge of the design of the lifting equipment as enables them to assess the design of the item in order to establish appropriate criteria for a thorough examination

### **4.4 INSPECTION BODY:**

Employer of the competent person(s) who provide examination and testing services

### **4.5 NON DESTRUCTIVE TESTING (NDT):**

Testing carried out on the structure of the appliance to establish the presence, location and extent of any defects that can affect the integrity of that structure

**NOTE:** The techniques employed for non-destructive testing are such that they do not damage or alter the material under test. NDT is also known as non-destructive examination (NDE).

### **4.6 RESPONSIBILITY OF USER**

Person or organisation that has control of both the lifting operation and the crane operator, and has a responsibility to ensure that cranes and other equipment are properly maintained and thoroughly examined by a competent person

## **5.0 INSPECTION STANDARDS:**

This SIM procedure shall ensure that the relevant Quay Crane personnel involved; in-house or subcontracted, follow the locally applicable Standards and Codes during Inspections.

Examples of applicable international standards are as follows:

- a. VT/MT/PT/UT: Inspector's qualification, Instrument calibration, NDT Procedure and Acceptance criteria: AWS D 1.1 2006 section 6.
- b. The operator: ASNT TC-1A Level II qualified.
- c. NDT reports: vetted by a level III inspector.
- d. Applicable European Standards are:
- e. EN 473: for the qualification and certification of Personnel
- f. EN 13018 – Visual testing principles
- g. EN 970 – Visual testing of Fusion Welded Joints
- h. EN 1290 – Magnetic Particle testing
- i. EN 1714 – Ultrasonic testing
- j. EN 571 – Penetrant testing
- k. BS7121 – Code of practice for the safe use of cranes, Part 2: Inspection, maintenance and thorough examination.

Applicable Australian Standards are:

- a. AS 1554 For Structural Steel Welding
- b. AS 2207 for Ultrasonic Test
- c. AS 1171 for Magnetic Particle Test
- d. AS 2062 for Liquid Penetrant Test

In the absence of a local standard, the relevant European / Australian standards could be used subject to approval by an appropriate "Competent Person".

All reports shall be accompanied by the relevant Operators' Certificate and Instrument Calibration Certificate.

## **6.0 HOW TO USE THE STRUCTURAL INSPECTION MANUAL DOCUMENT:**

### **6.1 THE SIM:**

The following items shall be defined and entered in tables in each SIM:

- 6.1.1** Fracture and Non Fracture Critical Members (FCM and NFCM) identified by the OEM shall be entered into appropriate table below.
- 6.1.2** Description of each line item should align with those recommended by the OEM SIM. Where not aligned, a 'Competent Engineer' shall define appropriate amendment / inclusions and document clearly the reason for variance whether based on new information relating to Cranes history, operating experiences, new design criteria etc.
- 6.1.3** Inspection period shall be defined in '**cycles**' or '**time**' periods as appropriate. Where history, inspection / maintenance records and operating experience is documented that would allow amendment of the time periods the 'Competent Engineer' shall assess and confirm amendment of that time period if different from the OEM SIM recommendations.

### **6.2 ALIGNING AND INTEGRATING SIM TO MAINTENANCE SCHEDULE:**

The SIM must be incorporated into the maintenance / inspection program.

All tasks / inspections must be recorded.

If possible Port Engineering shall ensure the inspection requirements defined in the SIM are integrated and implemented in a manner that combines standard maintenance tasks with SIM inspection requirements in a practical and most 'ergonomic' manner in order to minimise outage and disruption the operational requirements of a Crane.

### **6.3 MAINTAINING SIM:**

Periodic reviews of the SIM shall be conducted as defined and required, but in any case shall be no longer than 12 months. Port Engineering is responsible for ensuring all history, experience and events during review periods are captured and amended in the SIM.

All amendments shall be approved by a "Competent Person".

## **7.0 INSPECTION REQUIREMENTS:**

The following sections describe the areas of a Quay Crane that shall be examined in a Structural Inspection.

It should be noted and understood that many cranes are constructed differently and thus the inspections shown in the following sections are indicative only and shown here for guidance.

Port Engineering is ultimately responsible to ensure all aspects of implementing the SIM and have clearly and accurately documented and approved by appropriate 'Bodies / Authorities', 'Competent Person/s', Regulatory Bodies (as applicable) etc.

### **7.1 PREPARATION FOR THOROUGH EXAMINATION:**

A meeting should be held between the port operator and the competent person in advance of the thorough examination. Prior to this meeting the port should prepare all relevant information regarding the crane to be examined. Information required by the competent person. Undertaking thorough examination will include, but not limited to, the following:

- Declaration of conformity (ie: EC if an European Crane)
- Rated Capacity Indicator/load limiter calibration certificate / settings
- The last report of thorough examination
- In-service inspection reports
- Maintenance records relating rectification of defects, malfunctions and modifications since last examination
- Information on the number of lifts, type of lifts and hours the crane has been used since last examination.  
Information on any overloads, dropping of loads or collisions with the crane.
- Records of any supplementary tests or inspections requested at the previous thorough examination.
- General arrangement drawings
- Wire rope certificates
- Original design codes if available.



At the meeting the competent person should request any further information he may require prior to undertaking the thorough examination. Discussion and agreement should be reached as to assistance that will be provided to the competent person and the safe system of work to be followed during the examination. The scope of the discussions should include;

- The date and time the examination is to take place.
- The timing, sequence and extents of the examination.

**Note:** It is essential that the time required by the competent person undertaking thorough examination is discussed and agreed with the port operator. It is important that sufficient time is allocated and that the competent person is not put under undue time constraints and pressure.

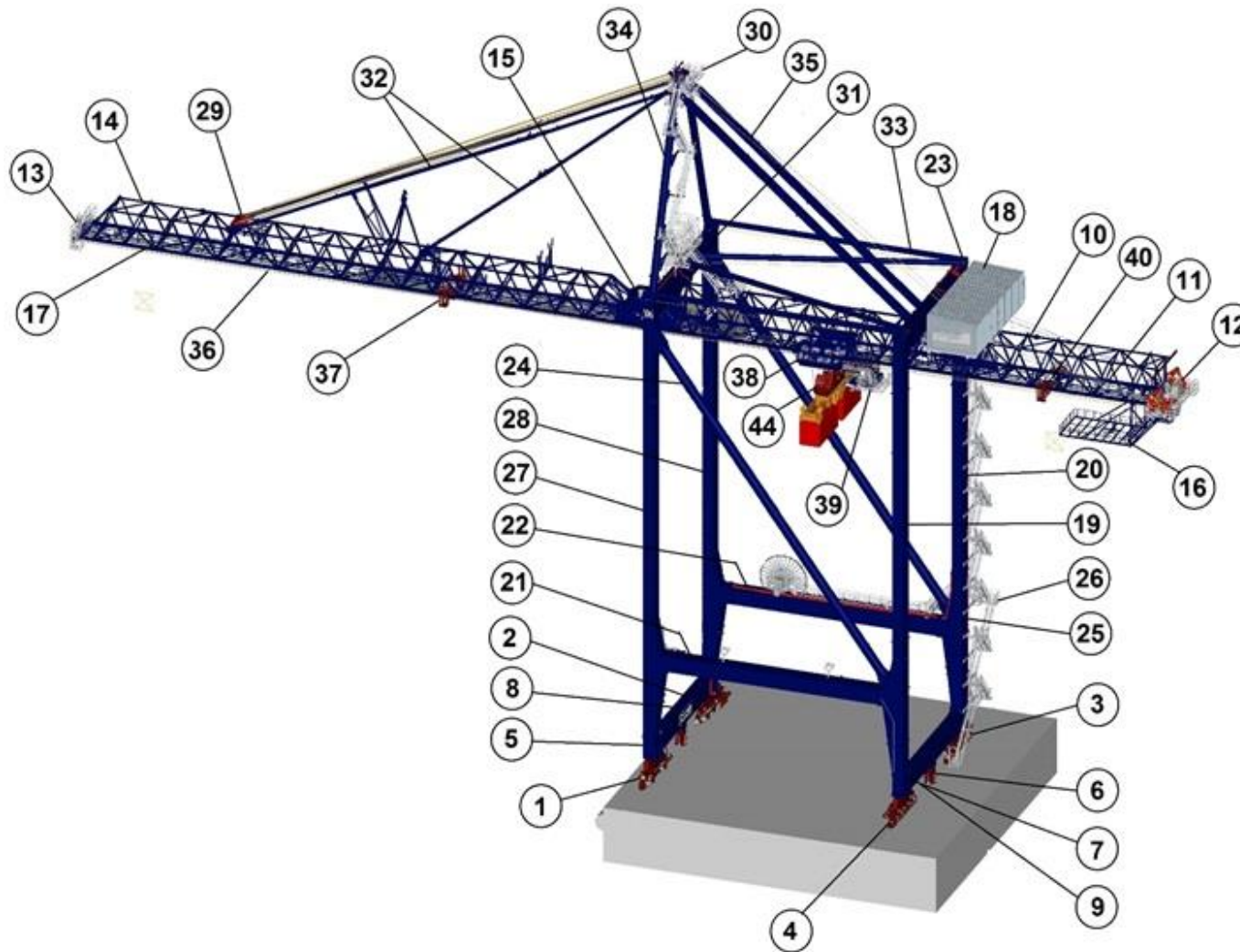
- Arrangements for the isolation of sources of power and establishment of a safe system of work
- Access arrangements for working at height
- Removal of inspection covers and hatches
- Arrangements for parts of the crane to be cleaned prior to thorough examination by appropriate means, e.g. pressure washed, to remove all spoil/dirt that would otherwise conceal the structure or mechanisms and prevent an effective examination.
- Provision of supplementary lighting
- Provision of specialist instruments, tools and equipment
- Arrangements for functional checks of the crane
- Communication methods between the competent person, crane operators and maintenance personnel during examination of the crane. i.e. radio communication.

In the event that the competent person has not examined the crane on a previous occasion it is strongly recommended that he/she is given the opportunity to view the crane prior to the thorough examination commencing.

Prior to the examination commencing the competent person should hold a briefing meeting with any operational or maintenance personnel that may be providing assistance. At this meeting he/she should;

- Explain and confirm the safe system of work he/she will be following,
- Provide information as to the extents and sequence of the examination he/she will be undertaking.
- Confirm the assistance he/she will require from each individual.
- Confirm and check communication methods within the team.

## 8.0 CRANE LEGEND



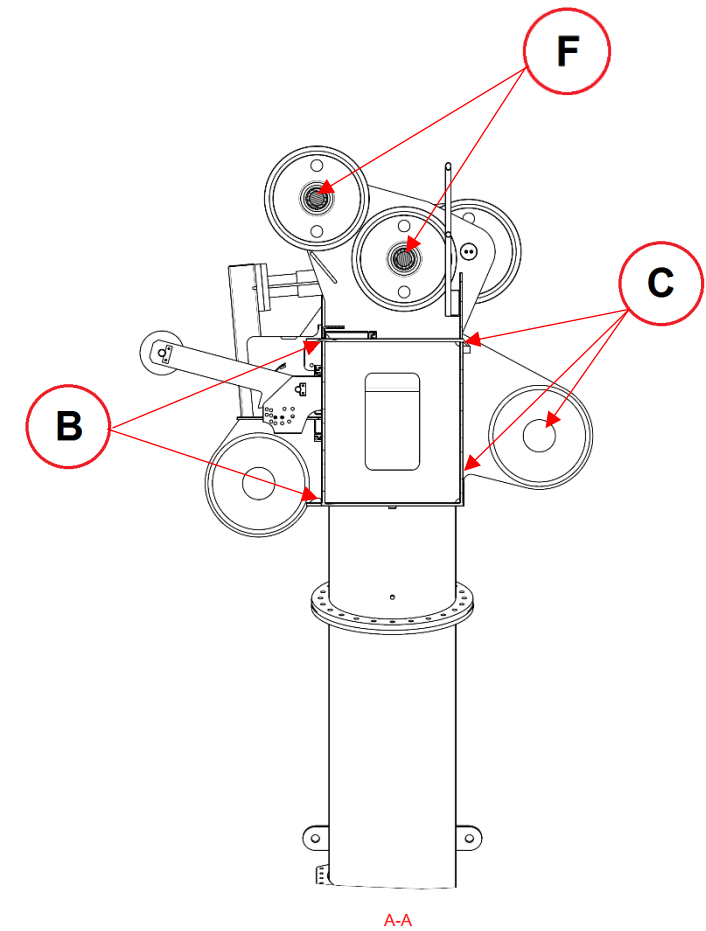
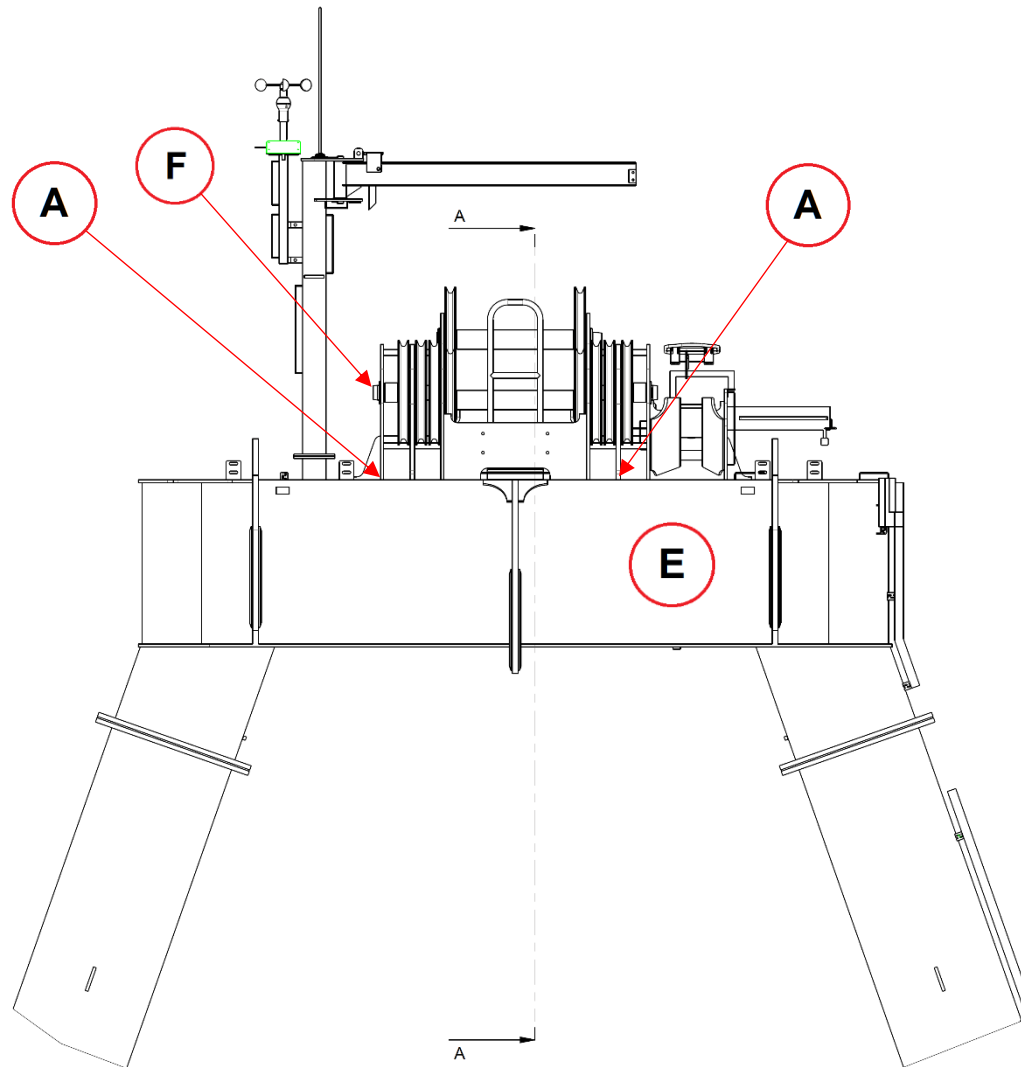
ITEM DESCRIPTION	DRG. NO.
1. TRAVEL UNIT 1	-110.000
2. TRAVEL UNIT 2	-120.000
3. TRAVEL UNIT 3	-130.000
4. TRAVEL UNIT 4	-140.000
5. CRANE TIE DOWNS (Not Applicable)	-150.000
6. RAIL BRAKES + STORM PINS	-160.000
7. CHECKERS CABIN (Not Applicable)	-170.000
8. END-CARRIAGE SEASIDE	-180.000
9. END-CARRIAGE LANDSIDE	-190.000
10. MAIN BEAM	-210.000
11. ENERGY CHAIN SYSTEM	-220.000
12. TRIM / LIST / SKEW + PLATFORM	-230.000
13. HOIST OVERLOAD SYSTEM	-240.000
14. DERRICK BOOM	-250.000
15. HOIST ROPE DEFLECTION ARM	-260.000
16. CABIN CLEANING PLATFORM	-270.000
17. TROLLEY TRAVEL LIMIT SWITCHES	-276.000
18. MACHINERY/ELECTRICAL HOUSE	-290.000
19. LANDSIDE LEG 4	-310.000
20. LANDSIDE LEG 3	-320.000
21. SILL BEAM 1-4	-330.000
22. SILL BEAM 2-3	-340.000
23. LANDSIDE CARRIER	-350.000
24. PORTAL DIAGONAL	-361.000
25. PERSONNEL LIFT	-370.000
26. MAIN ENTRY	-380.000
27. SEASIDE LEG 1	-410.000
28. SEASIDE LEG 2	-420.000
29. DERRICK BOOM CROSS BEAM	-430.000
30. A-FRAME ACCESS	-440.000
31. SEASIDE CARRIER	-450.000
32. HOLDING ARM	-460.000
33. CARRIER PLAN BRACING	-470.000
34. A-FRAME	-480.000
35. A-FRAME BACK TIE	-490.000
36. SUPPORT TROLLEY ROPE REEVING	-630.000
37. HOIST ROPE SUPPORT TROLLEY (	-640.000
38. TROLLEY ASSEMBLY	-660.000
39. CABIN + ENTRY PLATFORM	-670.000
40. HOIST ROPE SUPPORT TROLLEY	-640.000
41. BINDING FOR MAIN GROUPS	-700.000
42. ACCESSORIES	-800.000
43. CABLE CHANNELS (SITE)	-850.000
44. HEADBLOCK	-900.000

**9.0 A-FRAME - INSTRUCTION**

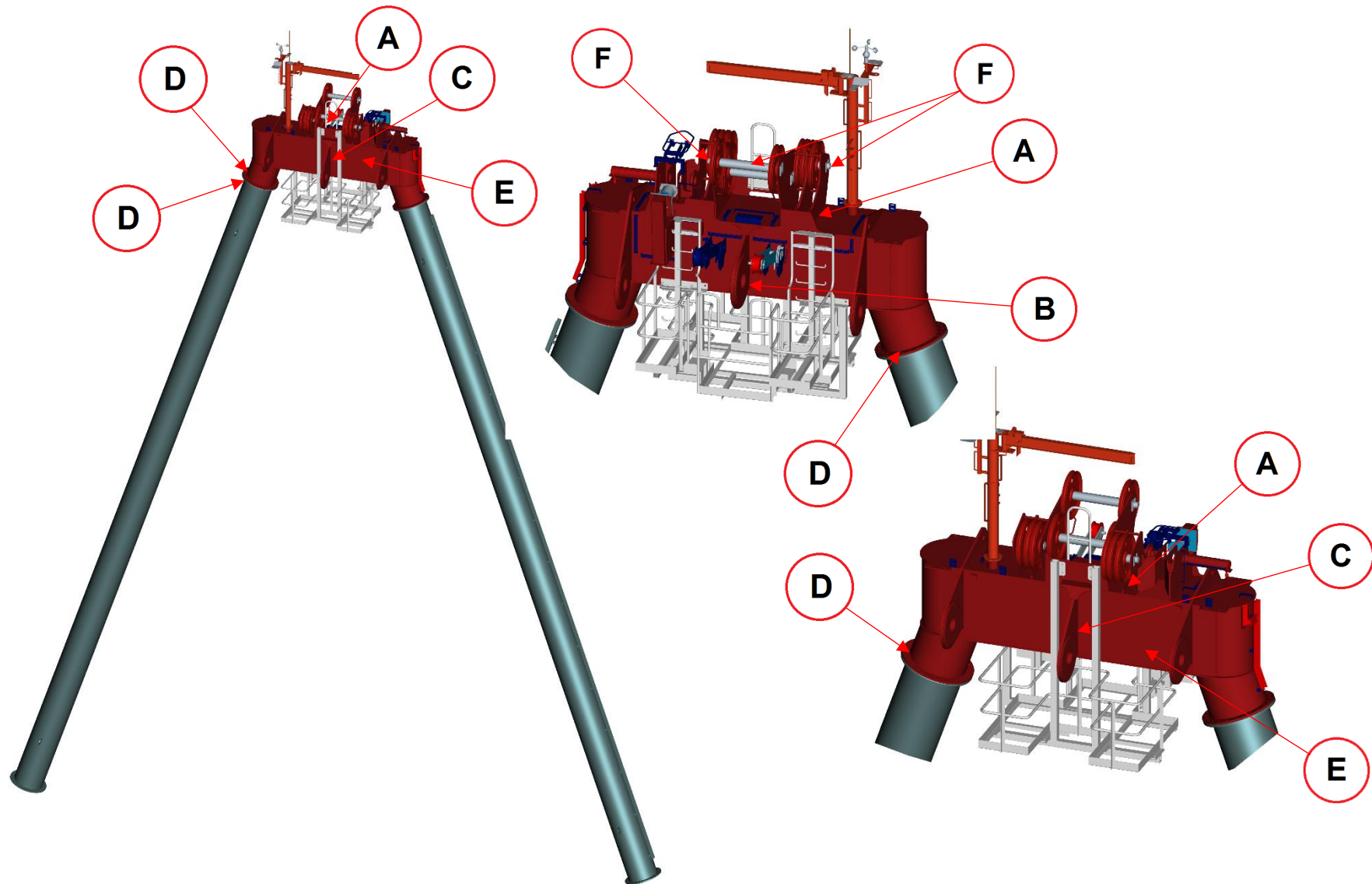
ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Connection of Boom Sheave block	3 months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
B	Back Tie Arm Connections (including pins), in particular the welding at the ends of the insert plates.	Annual	VT	Competent Person	Thorough Examination	FCM
C	Holding Arm connections: in particular the welding at the ends of the insert plates.	Annual	VT	Competent Person	Thorough Examination	FCM
D	Visual inspection of welds between Legs and Top Beam, from walkway	Annual	VT	Competent Person	Thorough Examination	FCM
E	Structural inspection of Top Beam (external from walkway)	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
F	Visual inspection of Sheave pins	3 Months	VT	Competent Person	Planned Maintenance	FCM

- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC / UT) shall be used if any areas show potential defects.

**9.1 A-FRAME - INSPECTION POINTS**



**9.2 A-FRAME - INSPECTION POINTS (3D)**

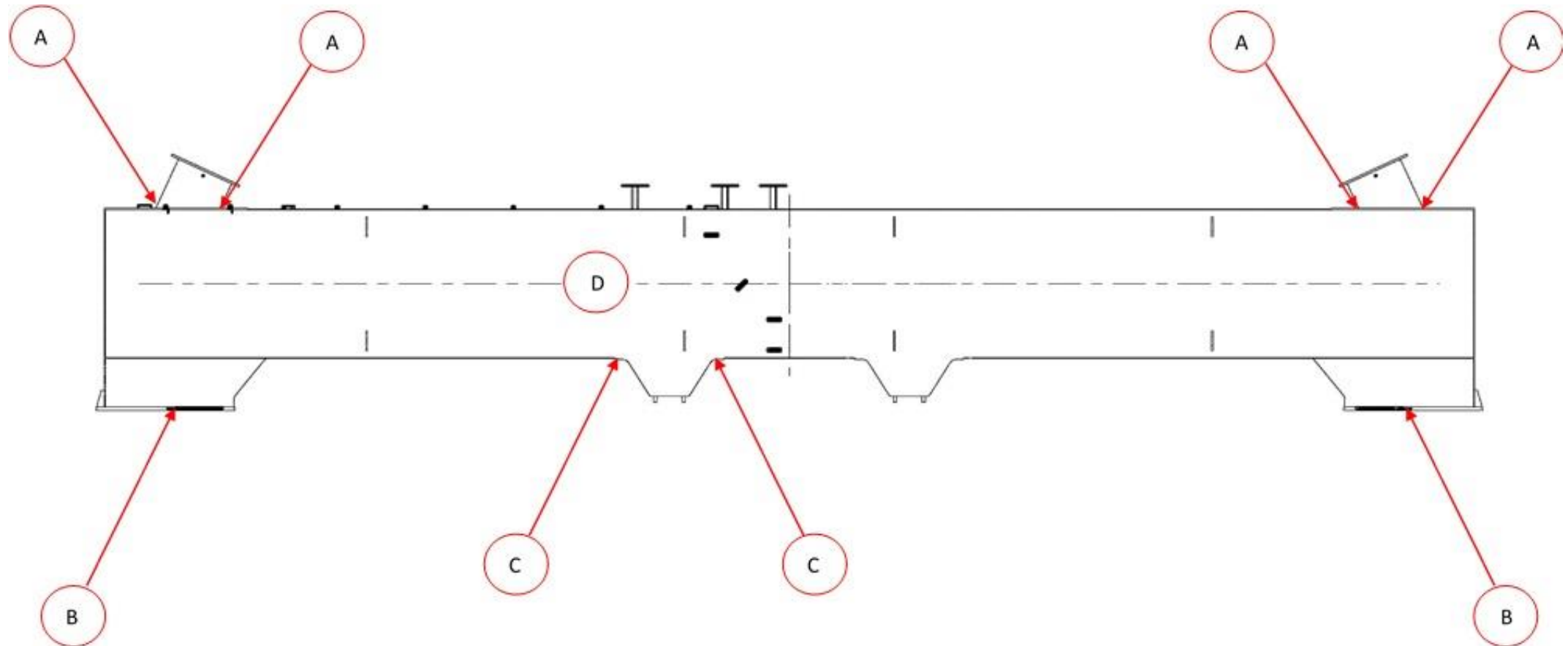


**10.0 SEASIDE CARRIER - INSTRUCTION**

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Connection of A frame legs	3 Months 4 Years	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
B	Connection to waterside legs	Annual	VT	Competent Person	Thorough Examination	FCM
C	Connection to Main Beam	Annual	VT	Competent Person	Thorough Examination	FCM
D	Seaside Carrier structure (external from walkway)	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM

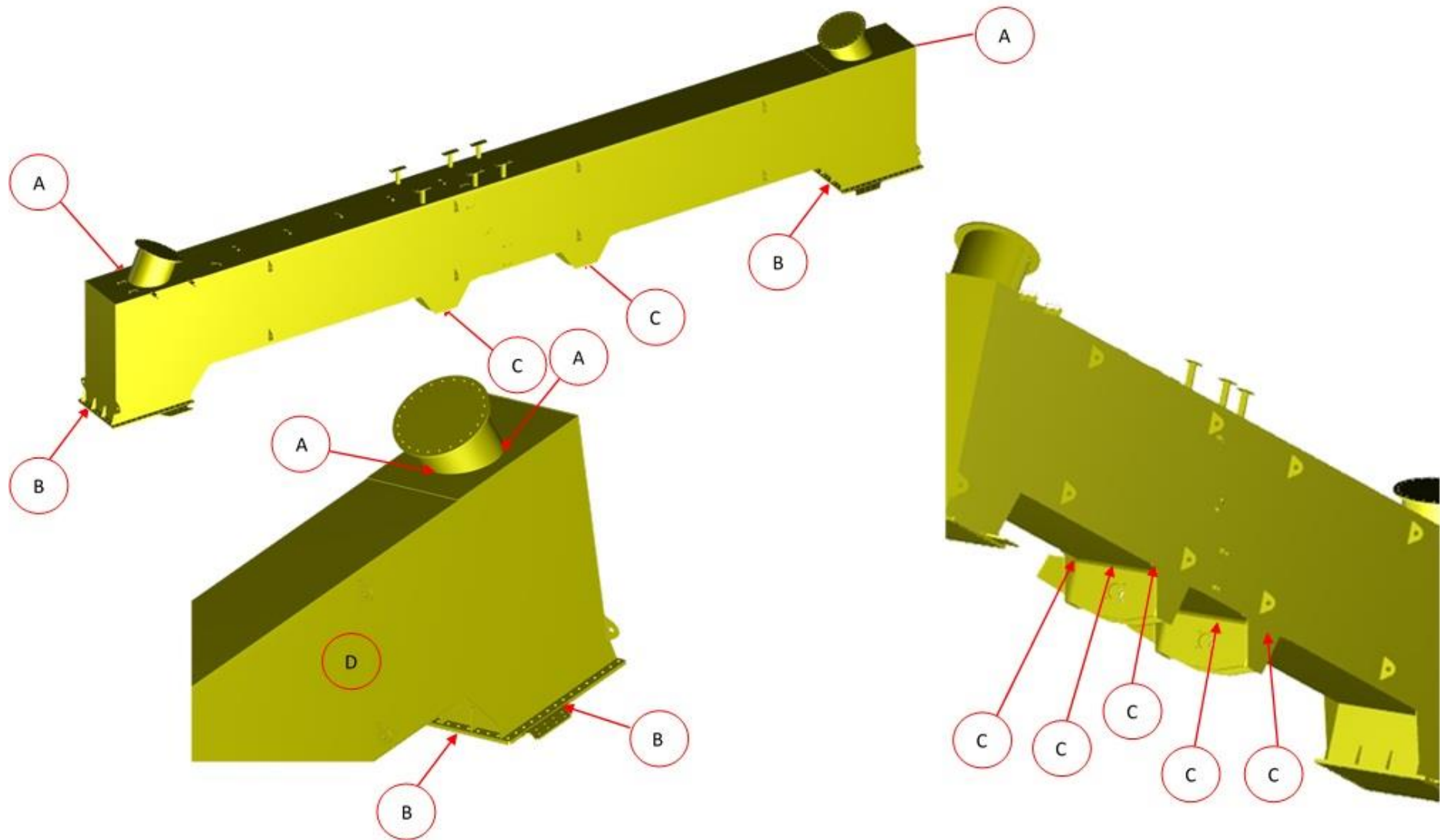
- Unless otherwise specified inspections shall be visual only; NDT (predominantly EC / UT) shall be used if any areas show potential defects.

**10.1 SEASIDE CARRIER – INSPECTION POINTS**





**10.2 SEASIDE CARRIER – INSPECTION POINTS (3D)**

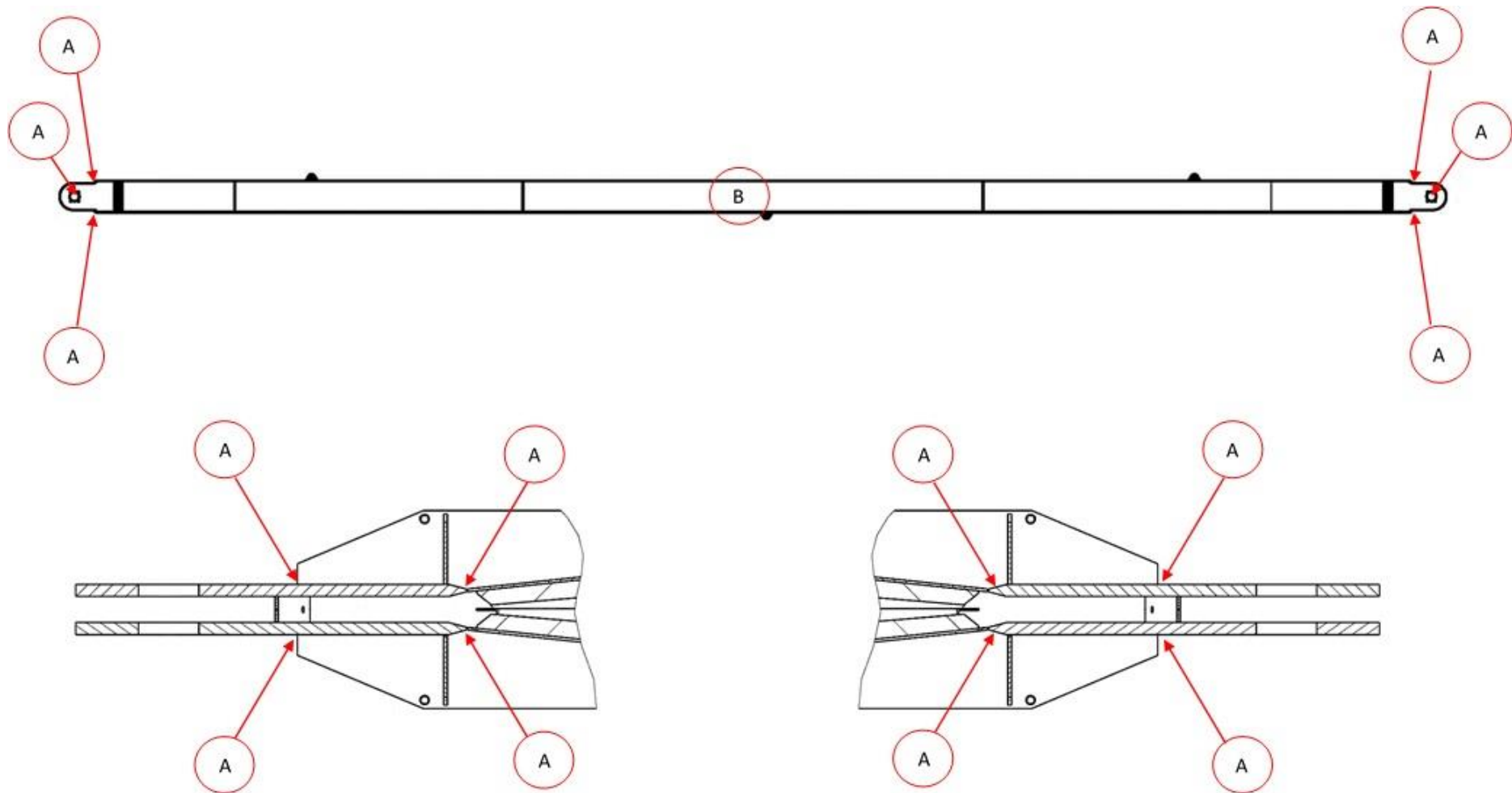


**11.0 A-FRAME BACK TIE - INSTRUCTION**

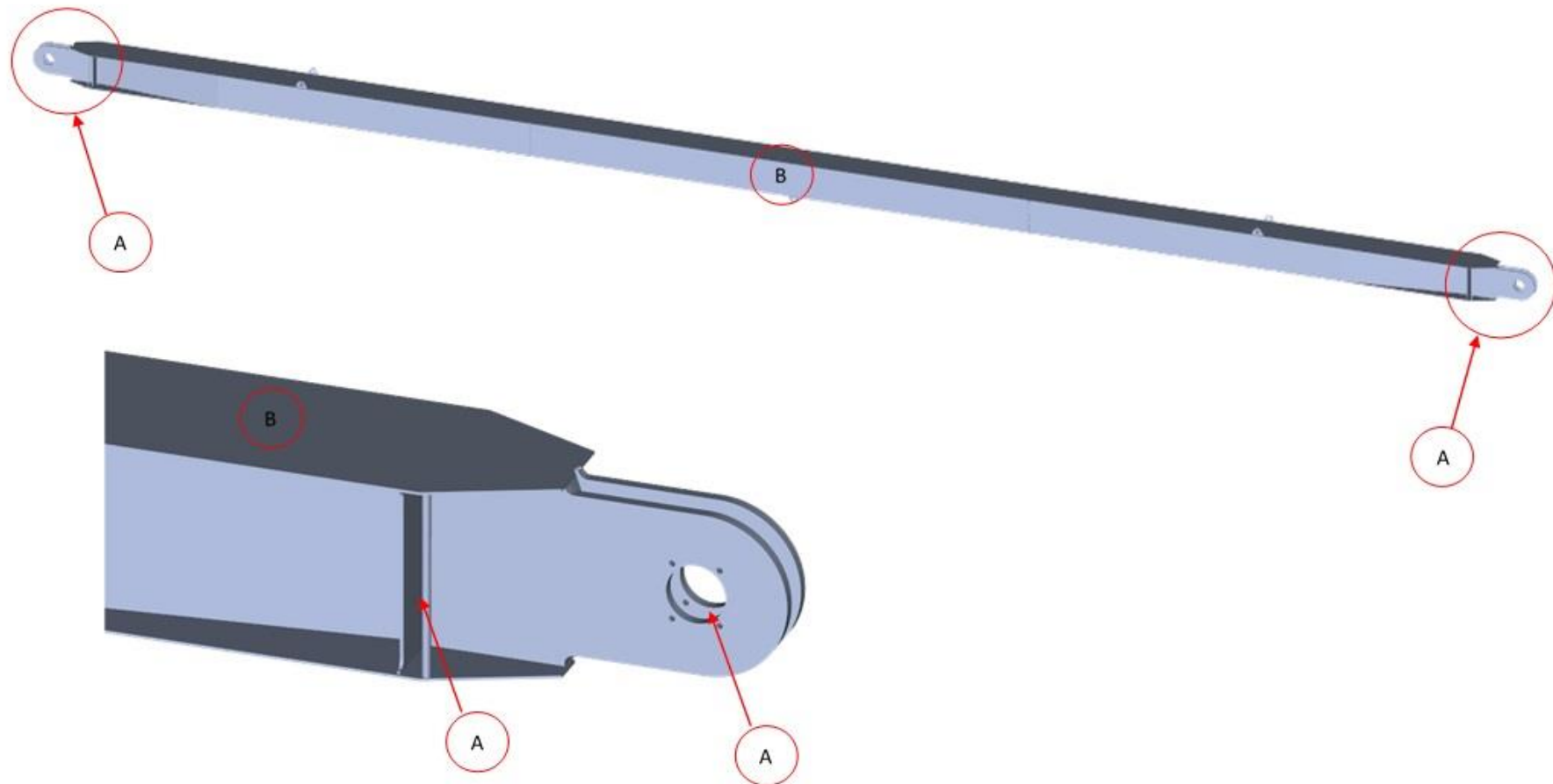
ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Detailed inspections of the ends top and bottom. In particular the welding at the ends of the insert plates. Visual inspection of pin and bores (external)	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
B	Visual inspection for the full length, concentration on any welded joints (butt welds) or attachments	4 Years	VT	Competent Person	Thorough Examination	FCM

- Unless otherwise specified inspections shall be visual only; NDT (predominantly EC / UT) shall be used if any areas show potential defects.

**11.1 A-FRAME BACK TIE – INSPECTION POINTS**



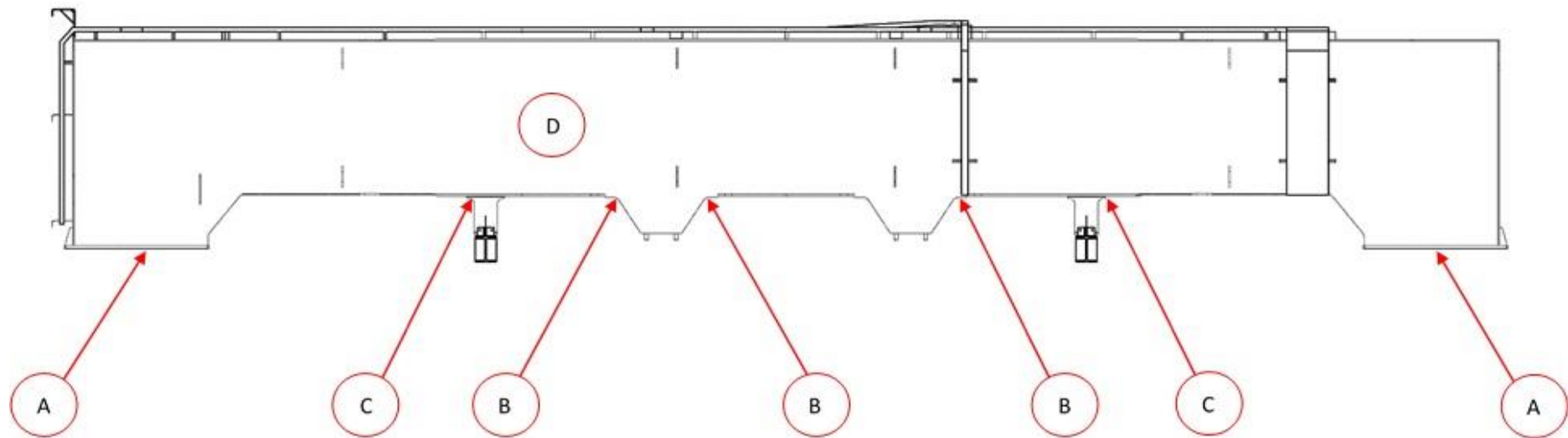
**11.2 A-FRAME BACK TIE – INSPECTION POINTS (3D)**



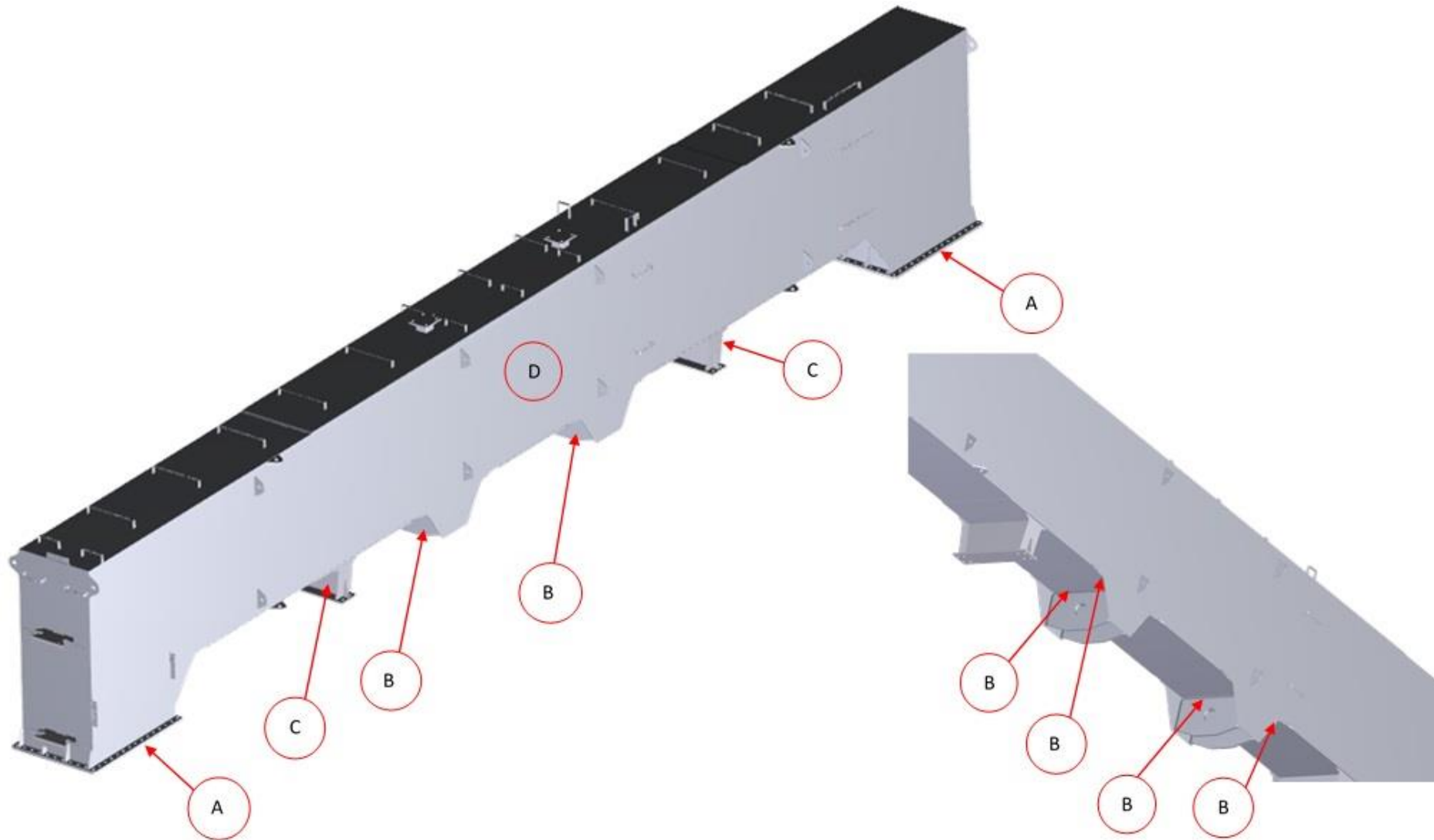
**12.0 LANDSIDE CARRIER - INSTRUCTION**

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Connection to landside legs	Annual	VT	Competent Person	Thorough Examination	FCM
B	Connection to main beam	3 Months	VT	Competent Person	Planned Maintenance	FCM
		Annual	VT		Thorough Examination	
C	Connection to Machinery House Supports	3 Months	VT	Competent Person	Planned Maintenance	FCM
		Annual	VT		Thorough Examination	
D	Landside Carrier Structure (external from walkway)	3 Months	VT	Competent Person	Planned Maintenance	FCM
		Annual	VT		Thorough Examination	
E	A-Frame Back Tie Arm Supports	3 Months	VT	Competent Person	Planned Maintenance	FCM
		Annual	VT		Thorough Examination	

- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC / UT) shall be used if any areas show potential defects.

**12.1 LANDSIDE CARRIER- INSPECTION POINTS**

**12.2 LANDSIDE CARRIER – INSPECTION POINTS (3D)**



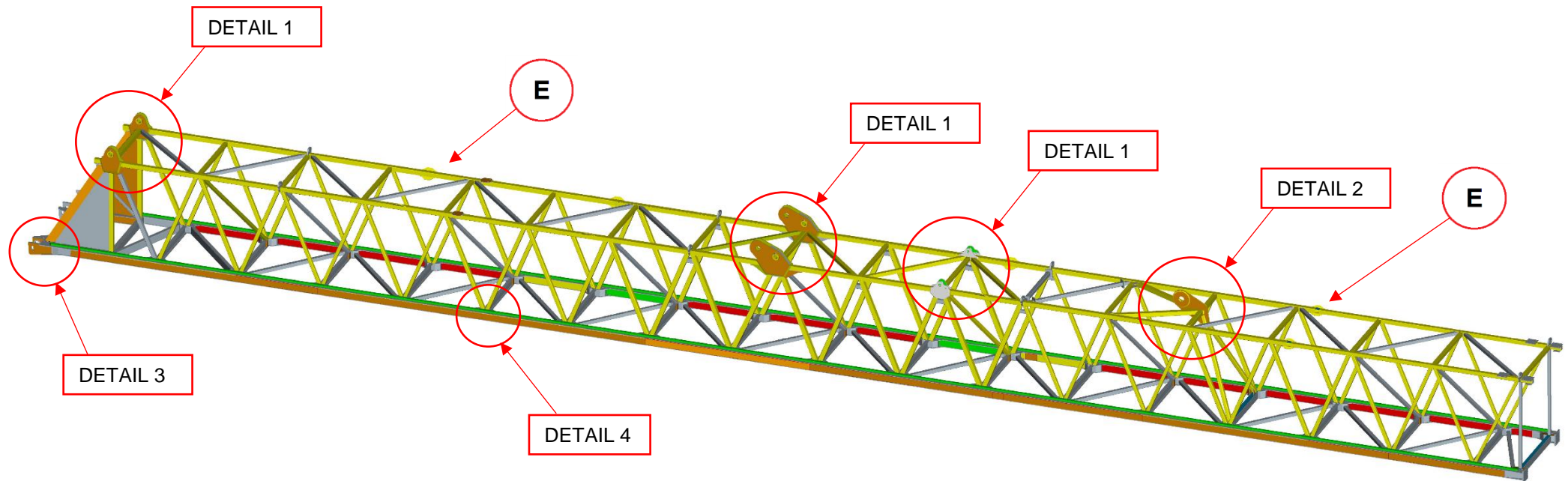
### 13.0 MAIN BEAM (LATTICE CONSTRUCTION) - INSTRUCTION

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Inspection of Main Beam hanger plates, where connected to top chords-including pins (Detail 1)	Annual	VT	Competent Person	Thorough Examination	FCM
B	Inspection of Main Beam hanger plates, where connected to vertical and diagonal members	Annual	VT	Competent Person	Thorough Examination	FCM
C	Inspection of A-Frame Back Tie Arm Connection plates, where connected to chords - including pins (Detail 2)	3 Months 4 Years	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
D	Inspection of A-Frame Back Tie Arm Connection plates, where connected to horizontal and diagonal members (detail 2)	Annual	VT	Competent Person	Thorough Examination	FCM
E	Examination of all site connections between members	Annual	VT	Competent Person	Thorough Examination	FCM
F	Examination of Hinge section, where welded to main sections (detail 3)	Annual	VT	Competent Person	Thorough Examination	FCM
G	Examination of vertical and diagonal bracings where connected to Hinge Sections (detail 3)	Annual	VT	Competent Person	Thorough Examination	FCM
H	Examination of the base of each vertical and diagonal member, where welded to bottom chord (detail 4)	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM

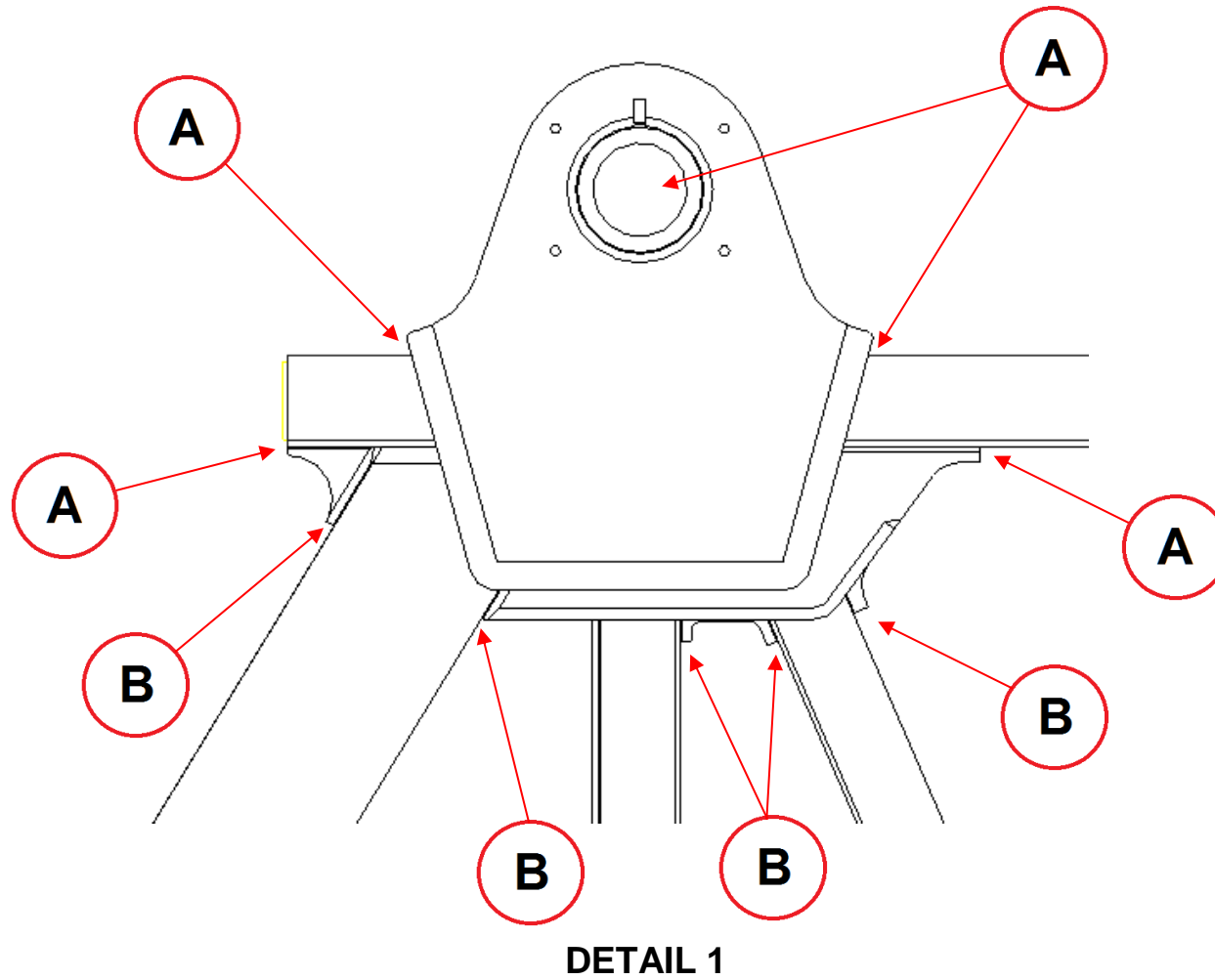
- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC/UT) shall be used if any areas show potential defects.



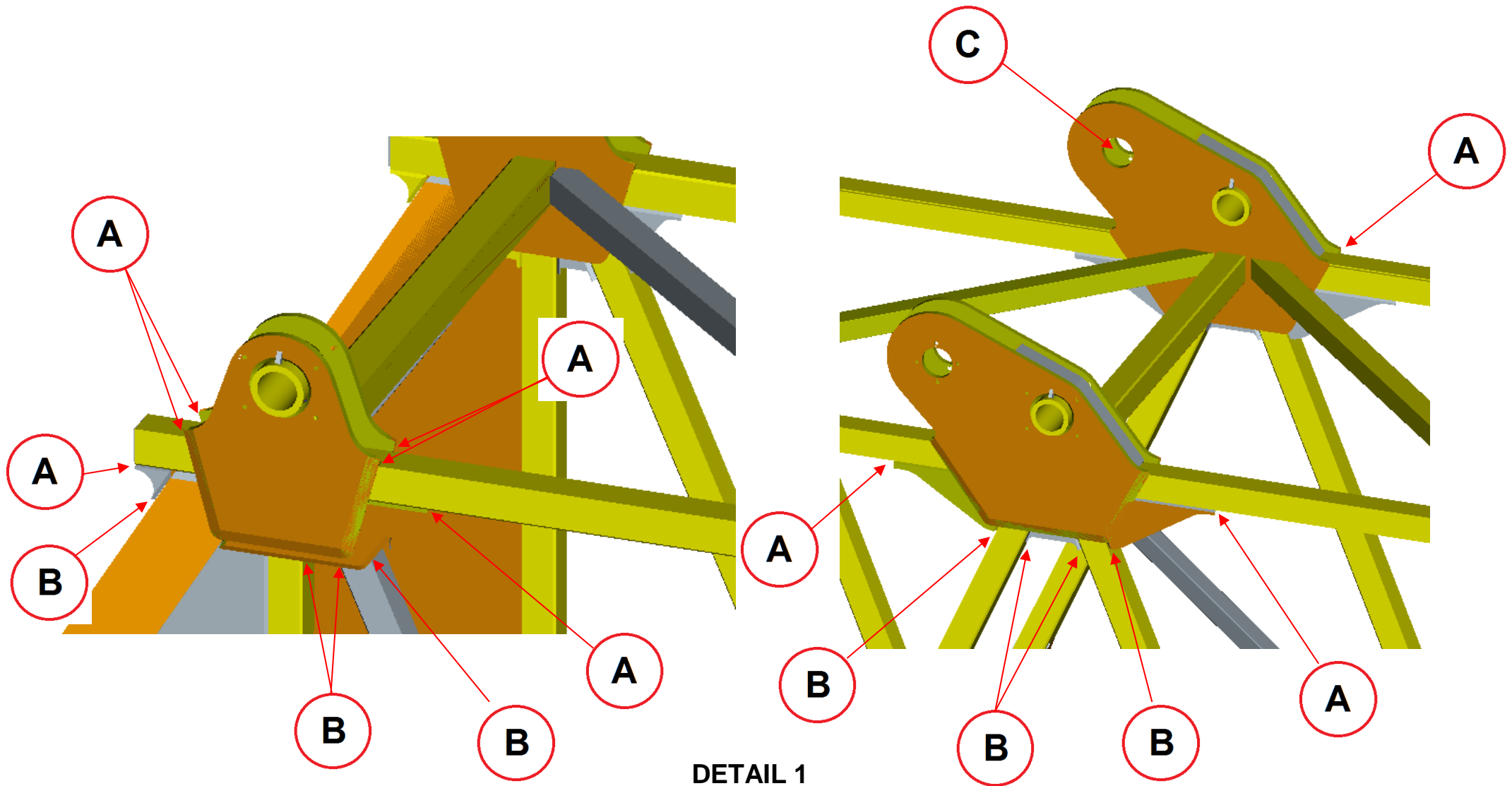
**13.1 MAIN BEAM (LATTICE CONSTRUCTION) – INSPECTION POINTS**



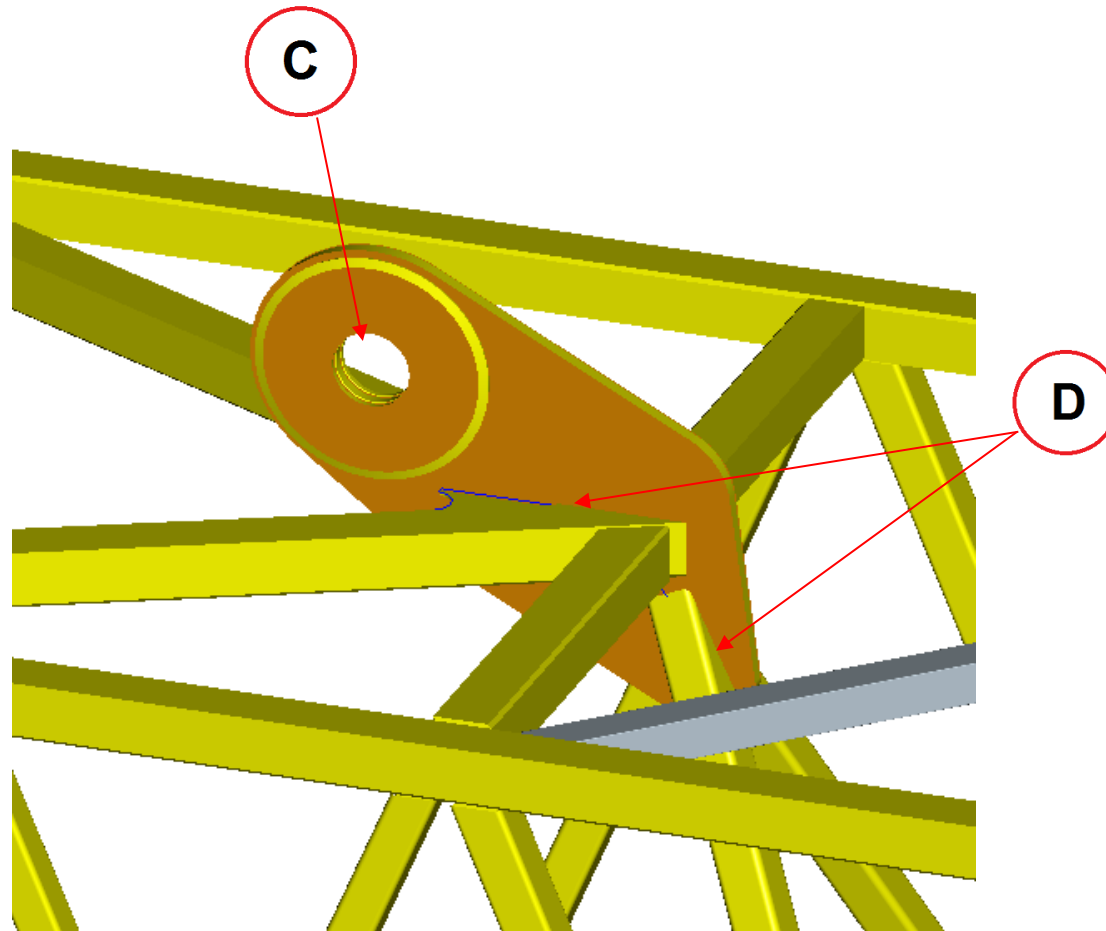
**13.2 MAIN BEAM (LATTICE CONSTRUCTION) – INSPECTION POINTS CONTINUED**



**13.3 MAIN BEAM (LATTICE CONSTRUCTION) – INSPECTION POINTS CONTINUED (3D)**

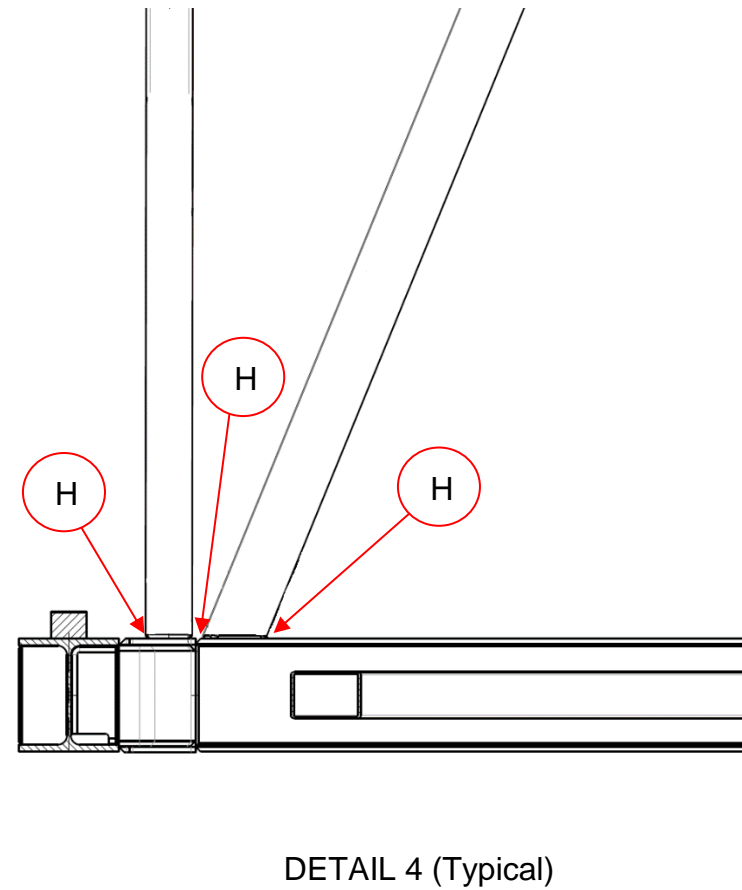
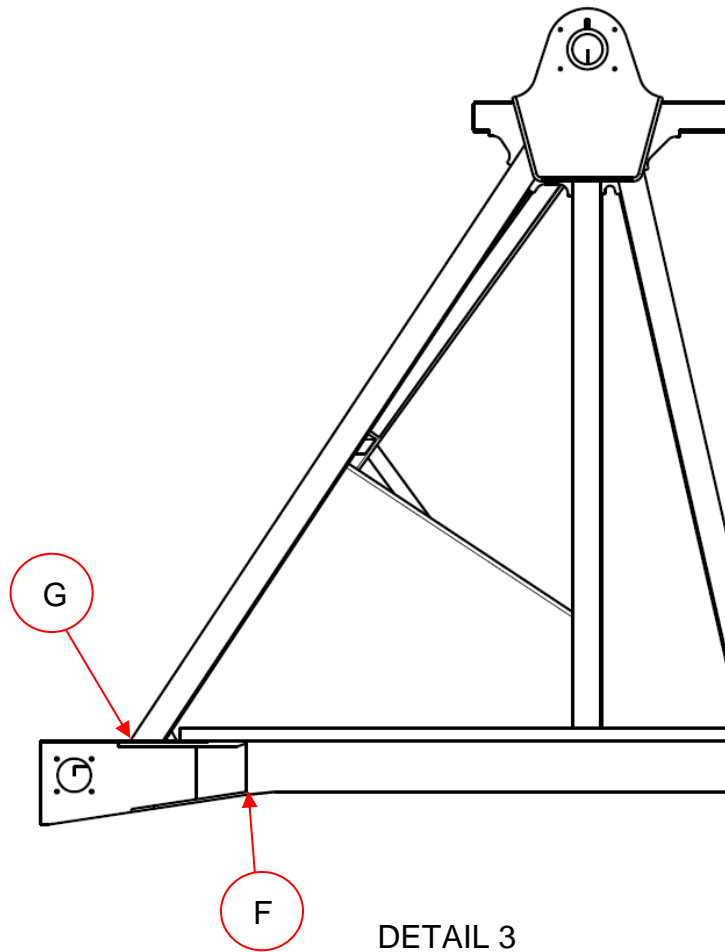


**13.4 MAIN BEAM (LATTICE CONSTRUCTION) – INSPECTION POINTS CONTINUED**

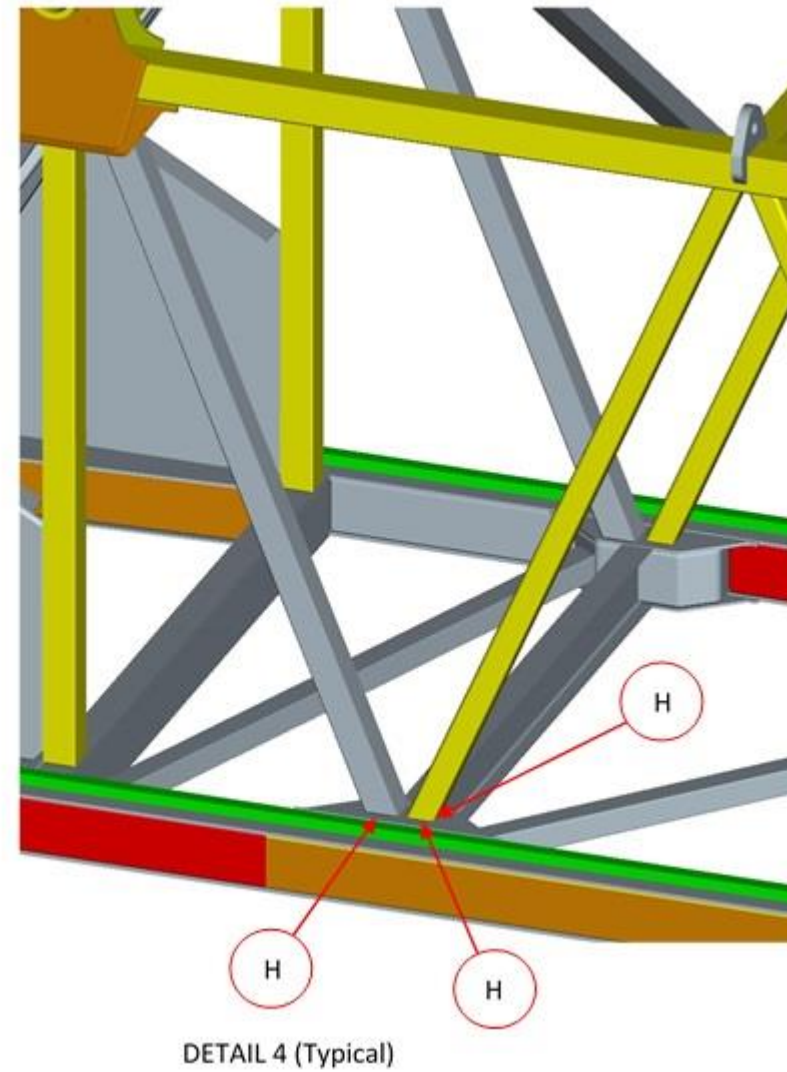
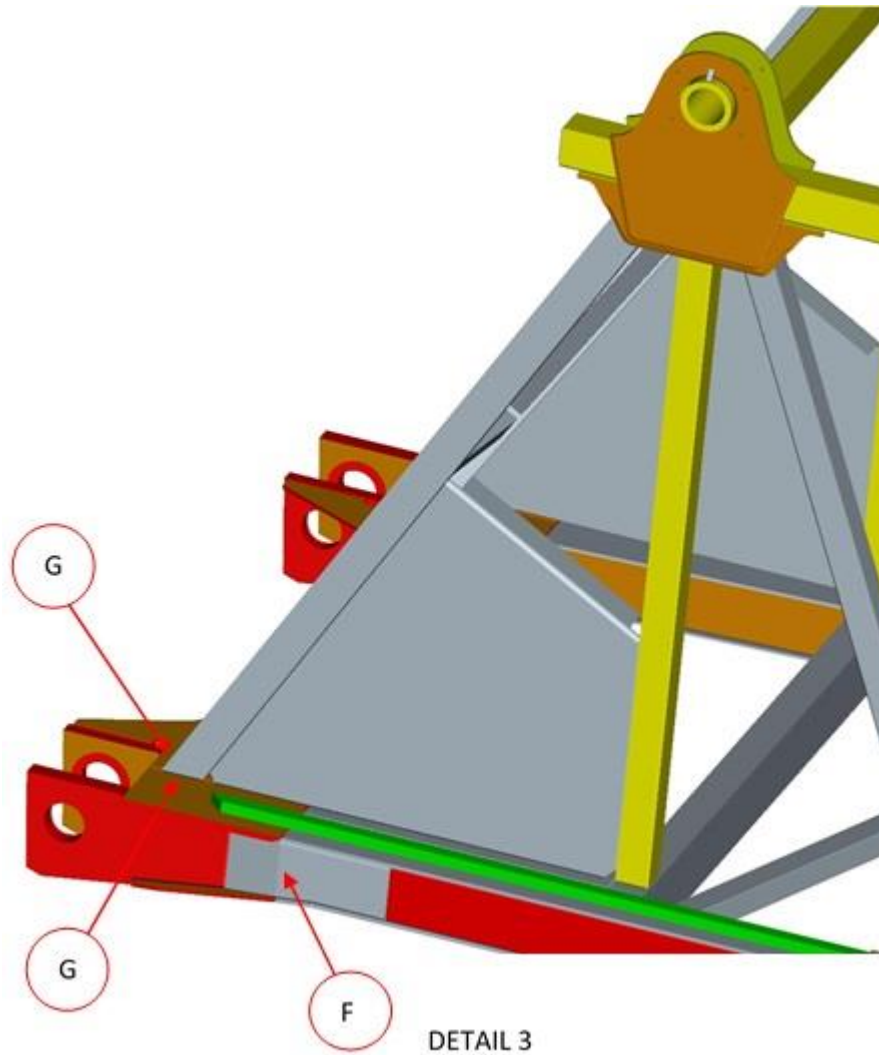


**DETAIL 2**

**13.5 MAIN BEAM (LATTICE CONSTRUCTION) – INSPECTION POINTS CONTINUED**



**13.6 MAIN BEAM (LATTICE CONSTRUCTION) – INSPECTION POINTS CONTINUED (3D)**



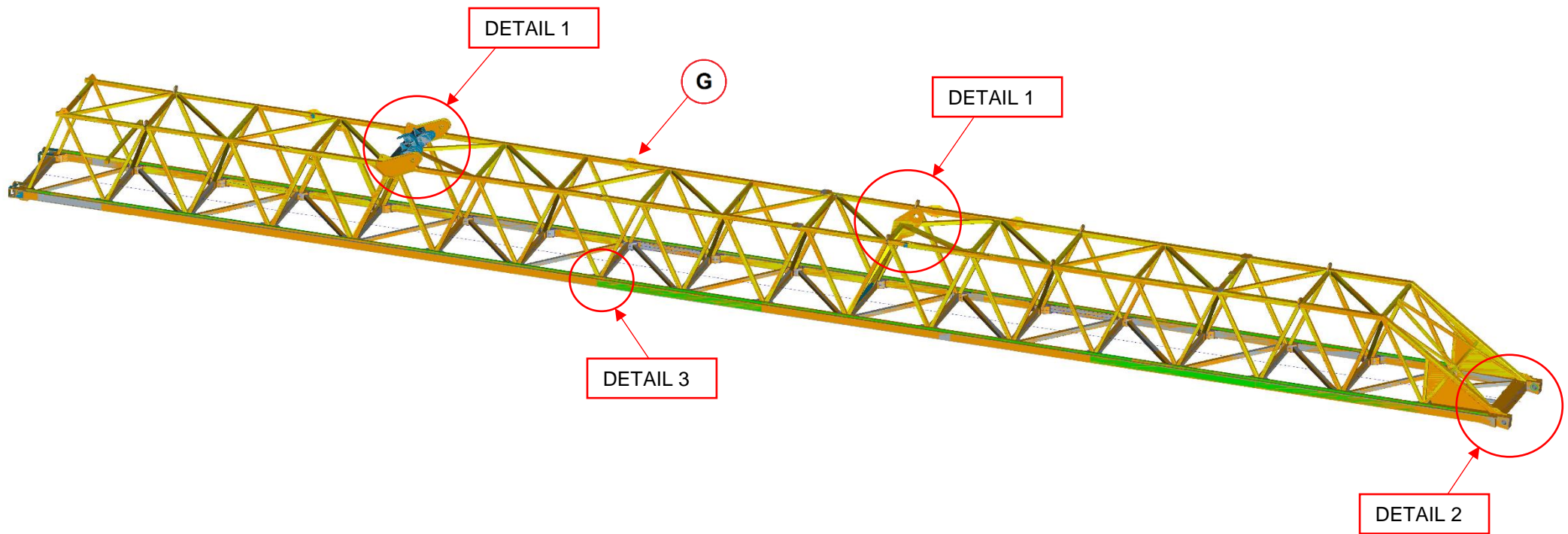
**14.0 DERRICK BOOM (LATTICE CONSTRUCTION) - INSTRUCTION**

ITEM	DESCRIPTION	INSPEC TION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Inspection of connection plates, where connected to top chords and crossbeam (Detail 1)	Annual 4 Years	VT VT	Competent Person	Thorough Examination	FCM
B	Inspection of Crossbeam connection plates, where connected to vertical, horizontal and diagonal members (Detail 1)	Annual 4 Years	VT VT	Competent Person	Thorough Examination	FCM
C	Inspection of Crossbeam Connection plates. Including pins. (Detail 1)	Annual 4 Years	VT VT	Competent Person	Thorough Examination	FCM FCM
D	Inspection of Holding Arm Connection Plates and Boom Sheave plates, where connected to vertical and diagonal members (Detail 1)	Annual 4 Years	VT VT	Competent Person	Thorough Examination	FCM
E	Examination of vertical and diagonal bracings where connected to hinge sections (Detail 2)	Annual	VT	Competent Person	Thorough Examination	FCM
F	Examination of Hinge Section, where welded to main sections	Annual	VT	Competent Person	Thorough Examination	FCM
G	Examination of all site connections between members	Annual	VT	Competent Person	Thorough Examination	FCM
H	Examination of the base of each vertical and diagonal member, where welded to bottom chord (Detail 3)	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM

- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC / UT) shall be used if any areas show potential defects.

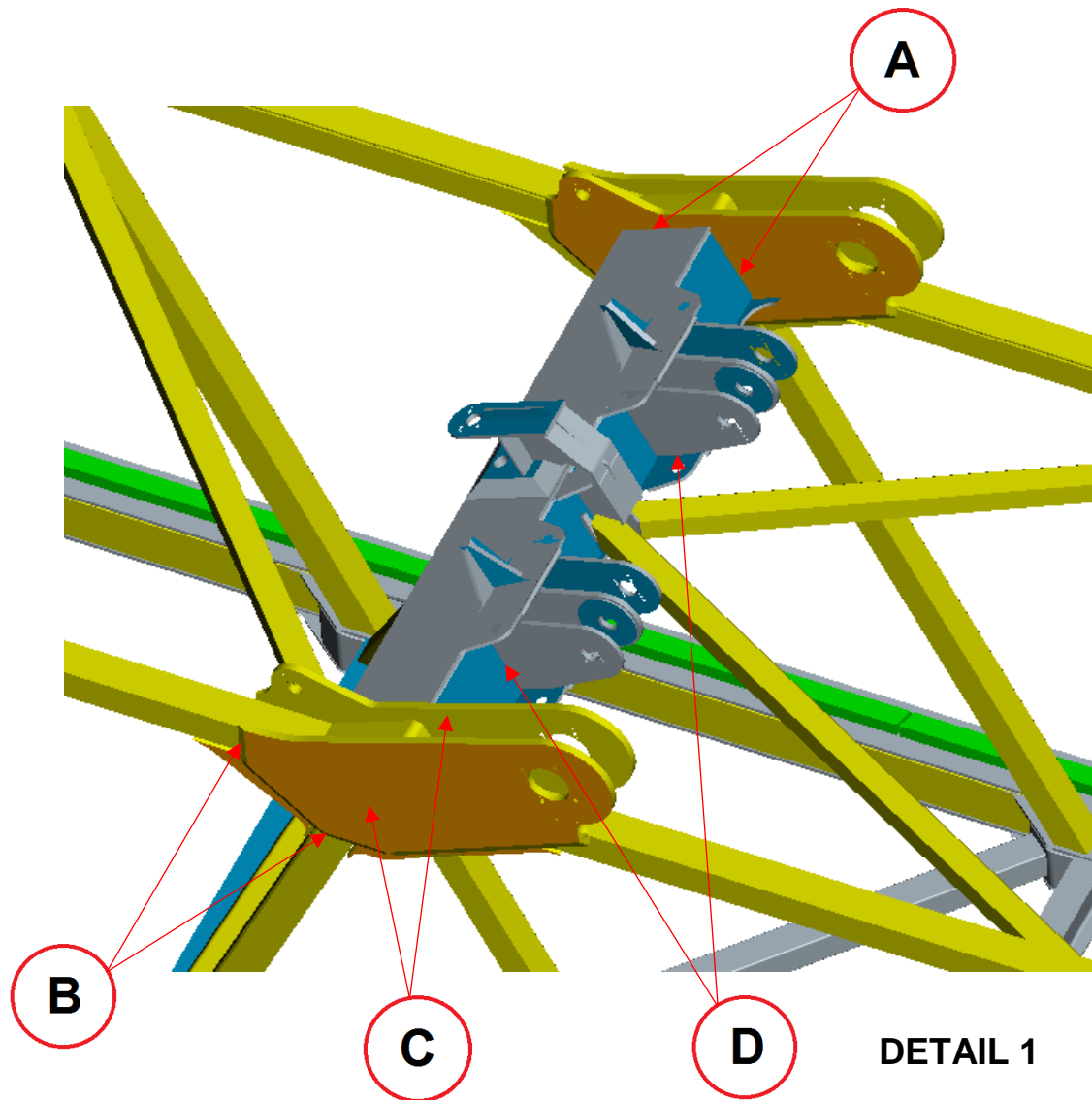


**14.1 DERRICK BOOM (LATTICE CONSTRUCTION) – INSPECTION POINTS**

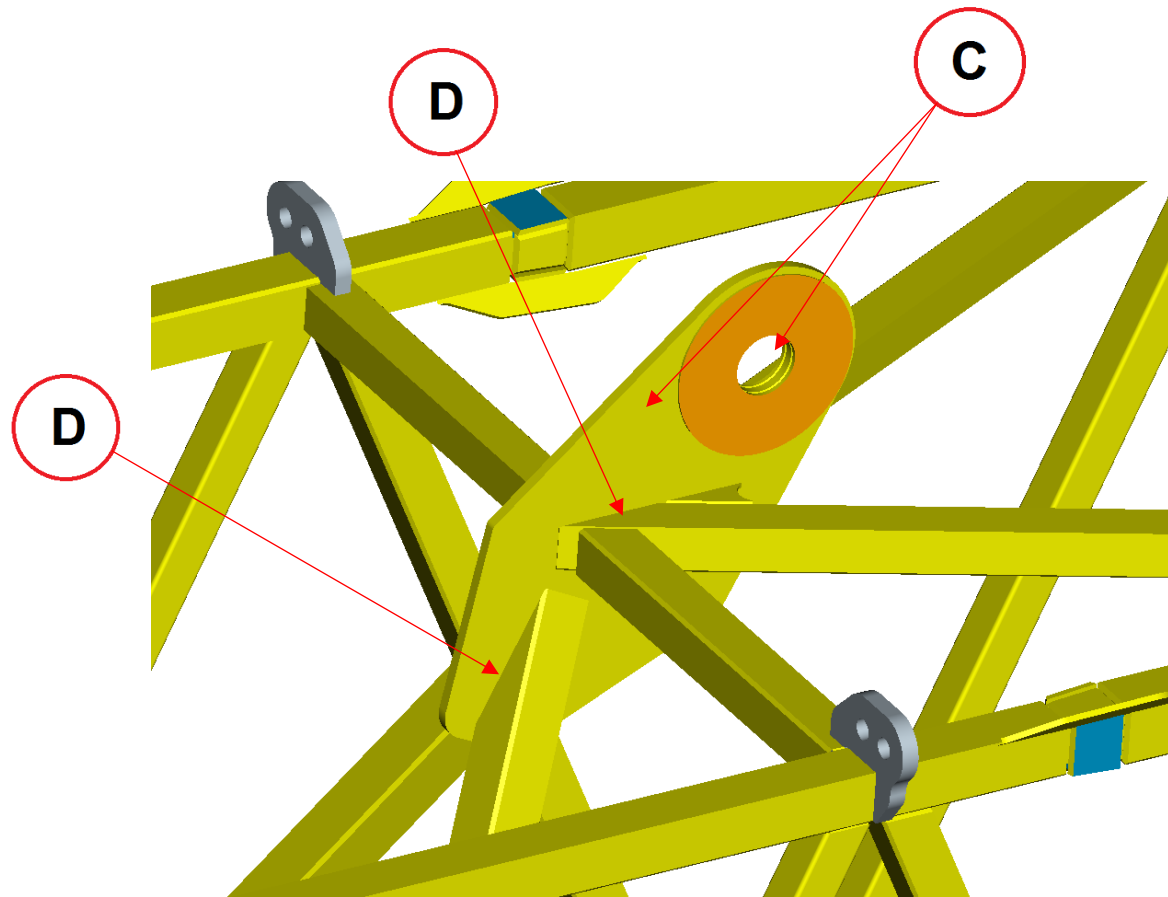




**14.2 DERRICK BOOM (LATTICE CONSTRUCTION) – INSPECTION POINTS (3D)**

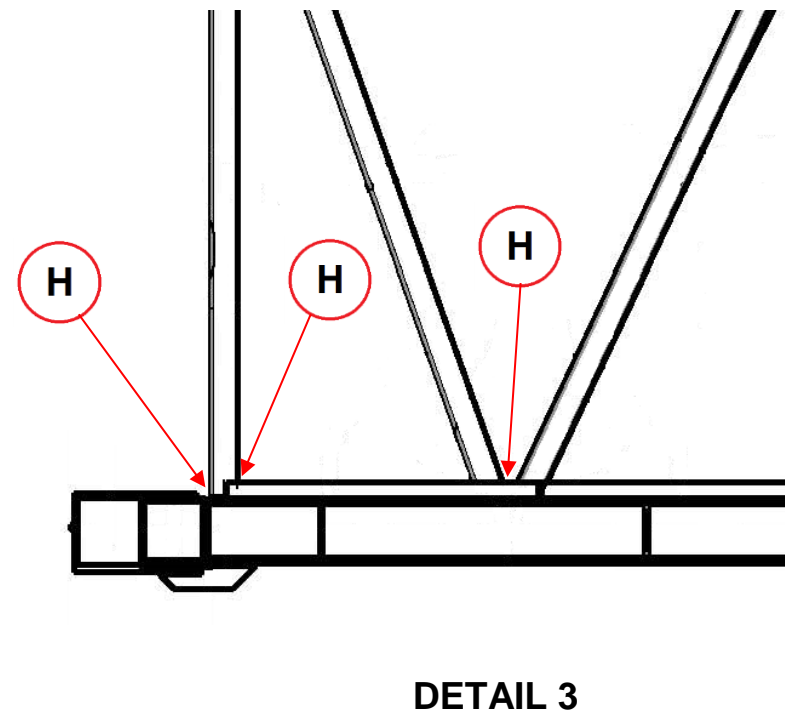
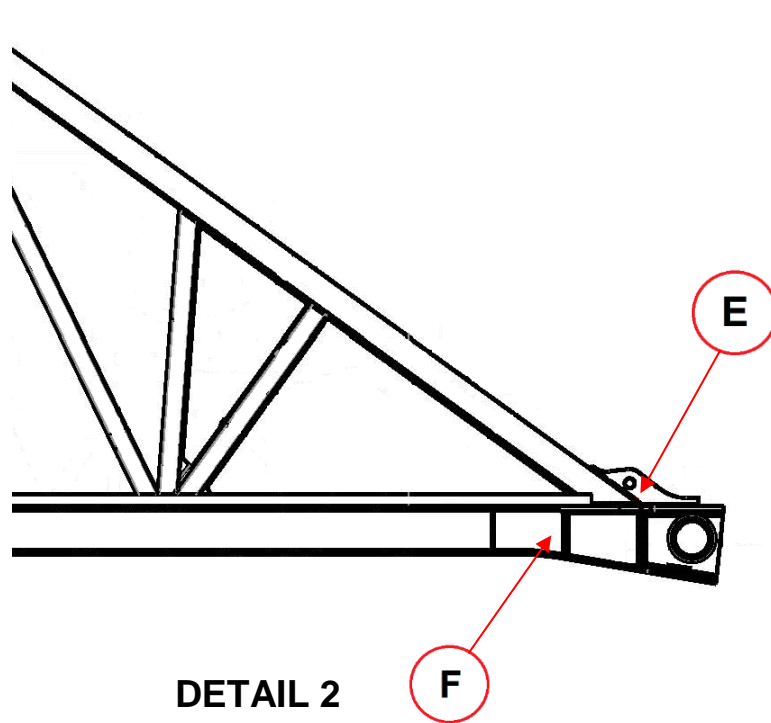


**14.3 DERRICK BOOM (LATTICE CONSTRUCTION) – INSPECTION POINTS (3D)**



**DETAIL 1**

**14.4 DERRICK BOOM (LATTICE CONSTRUCTION) – INSPECTION POINTS CONTINUED**

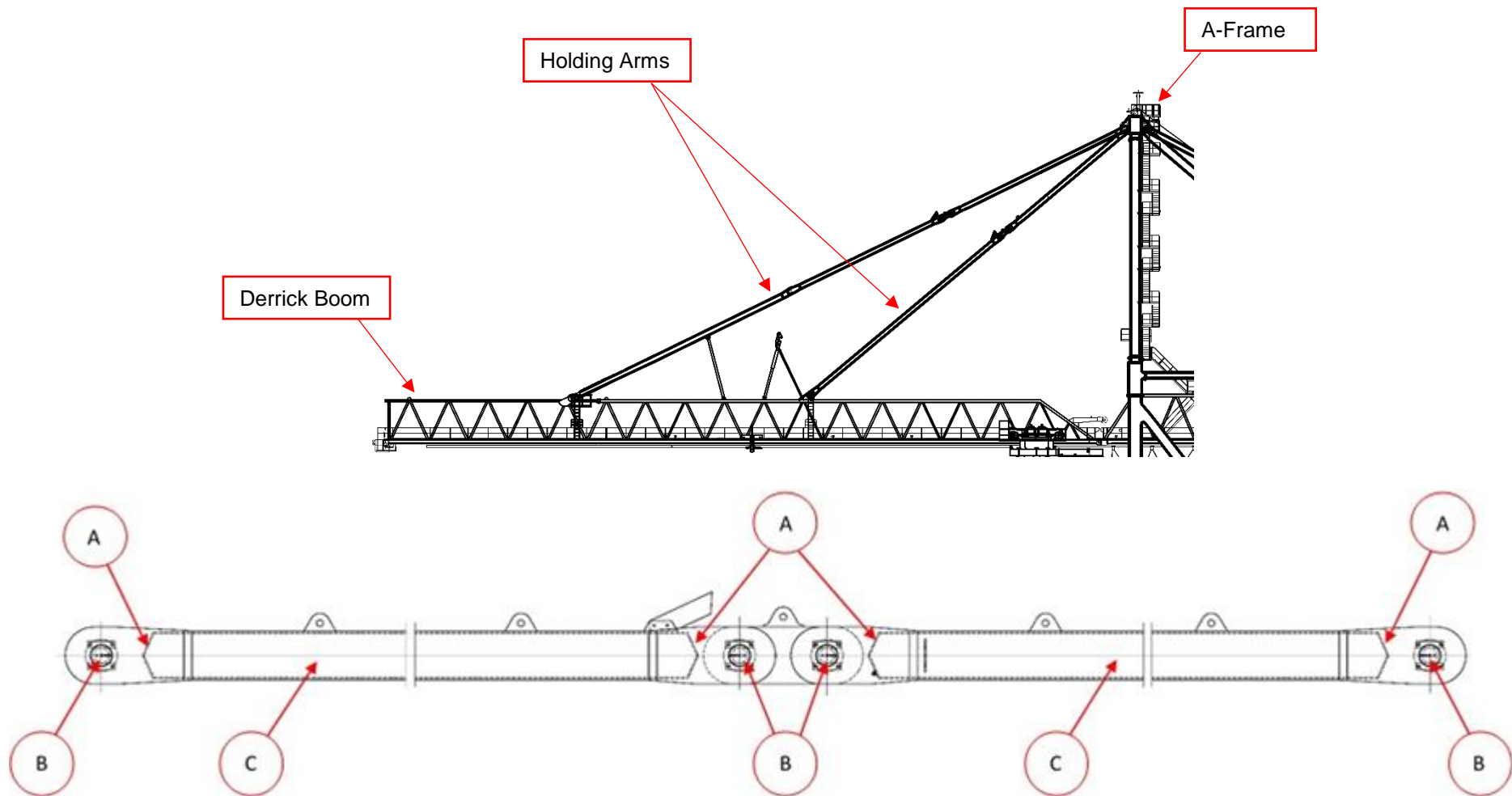


**15.0 HOLDING ARMS – INSTRUCTION**

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Inspections of the ends, top, bottom and centre links, in particular the welding at the ends of the insert plates.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
B	Pins and Bores					
B1	Visual	3 Months	VT	Competent Person	Planned Maintenance	FCM
B1	Ultrasonic	Annual	VT	Competent Person	Thorough Examination	FCM
C	Inspection of the full length, concentrating on any welded joints (butt welds)	4 Years	VT	Competent Person	Thorough Examination	FCM

- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC / UT) shall be used if any areas show potential defects.

## 15.1 HOLDING ARMS – ARRANGEMENT & INSPECTION POINTS

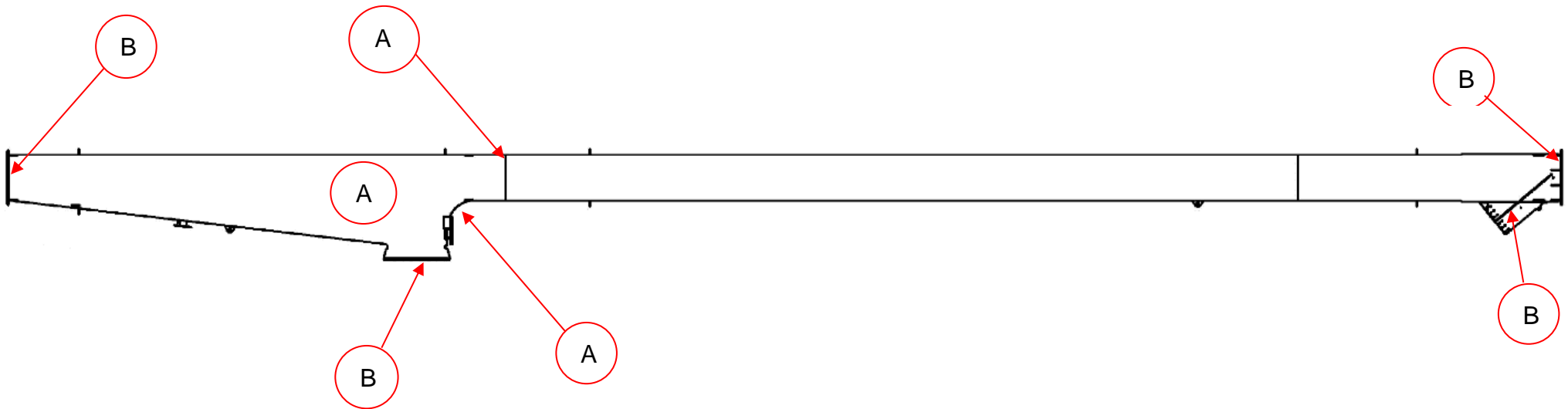


**16.0 LEGS - INSTRUCTION**

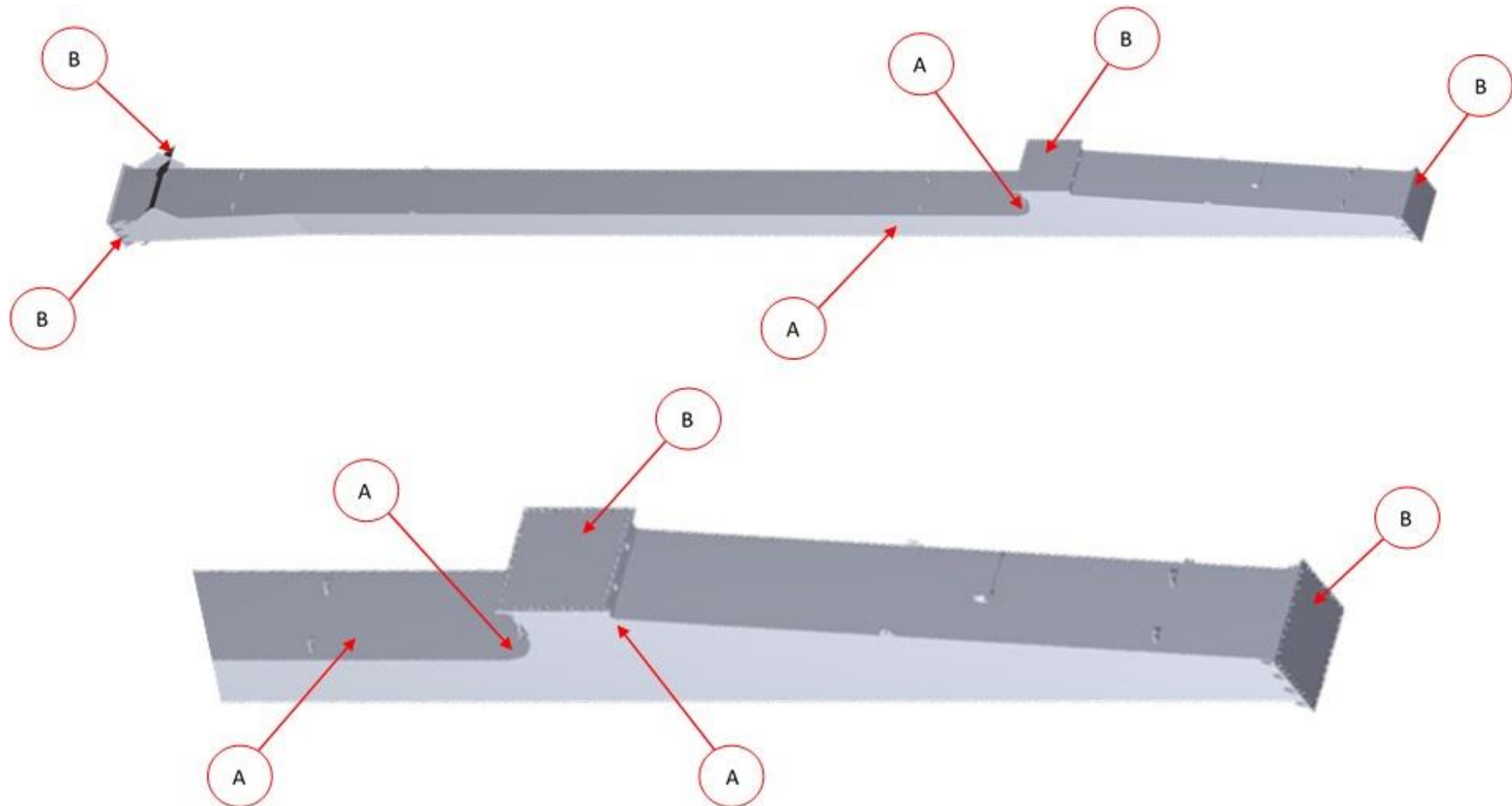
ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Full length external examination. In particular any welded joints and radii (in particular top of lower section)	4 Years	VT	Competent Person	Thorough Examination	NFCM
B	Connections to Landside and Seaside Carriers, sill beams and leg portals	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM

- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC / UT) shall be used if any areas show potential defects.

**16.1 LEGS – INSPECTION POINTS**



**16.2 LEGS – INSPECTION POINTS (3D)**



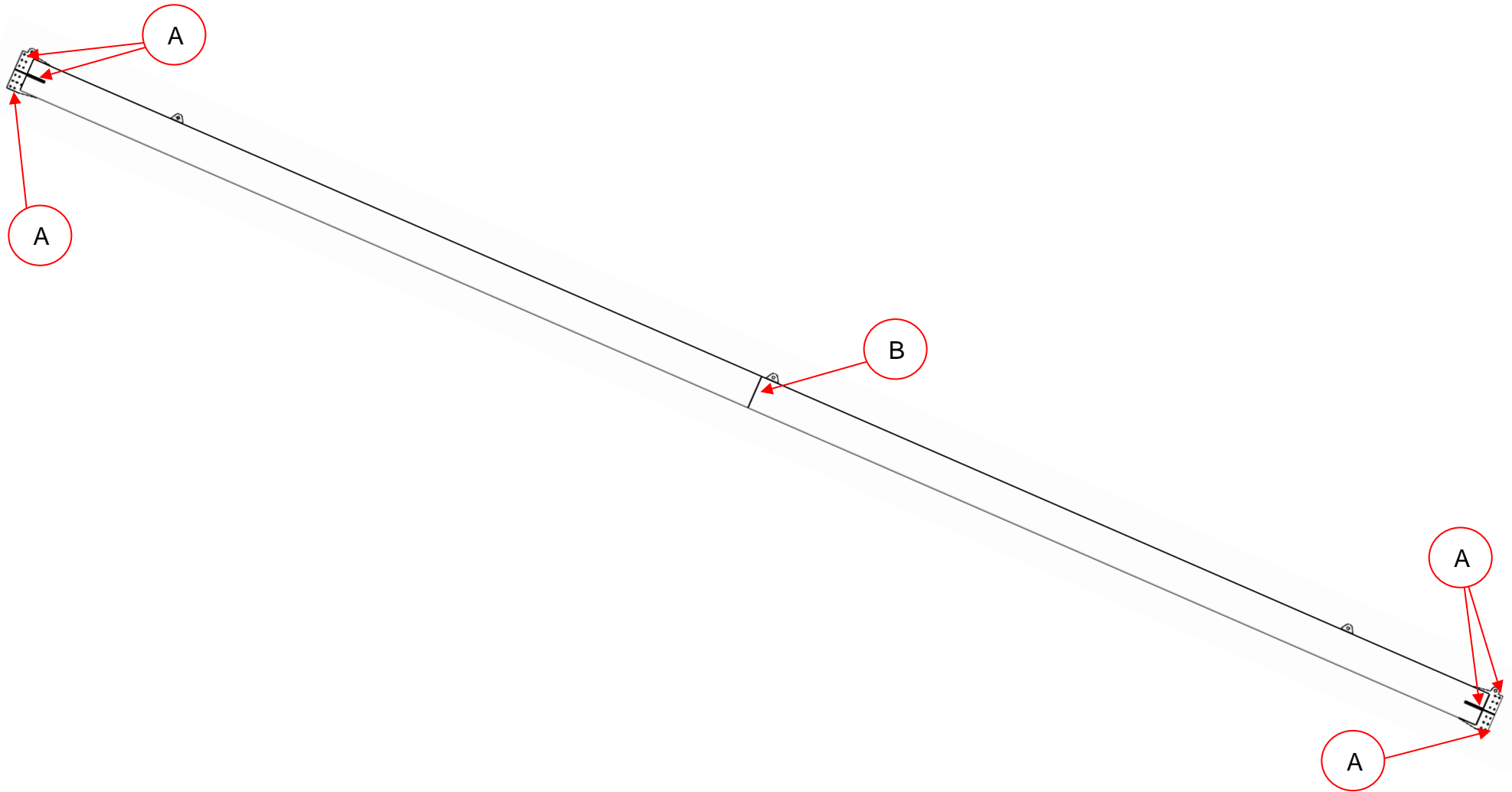


**17.0 PORTAL DIAGONAL – INSTRUCTION**

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Inspections of the ends, top and bottom. In particular the welding at the ends of the insert plates	Annual	VT	Competent Person	Thorough Examination	NFCM
B	Inspection for the full length, concentration on any welded joints (butt welds)	4 Years	VT	Competent Person	Thorough Examination	NFCM

- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC / UT) shall be used if any areas show potential defects.

**17.1 PORTAL DIAGONAL- INSPECTION POINTS**

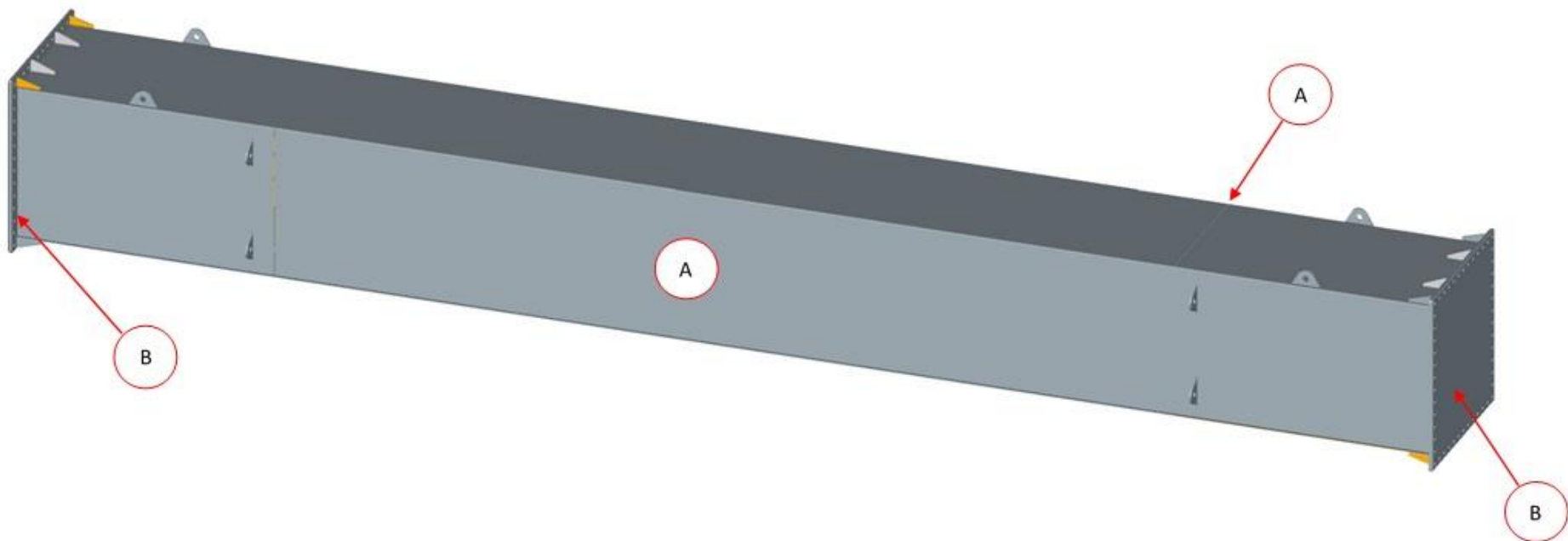


**18.0 SILL BEAMS – INSTRUCTION**

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Structure (external from walkway)	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM
B	Examination of the connection to the legs (external from walkways)	4 Years	VT	Competent Person	Thorough Examination	NFCM

- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC / UT) shall be used if any areas show potential defects.

**18.1 SILL BEAMS – INSPECTION POINTS**

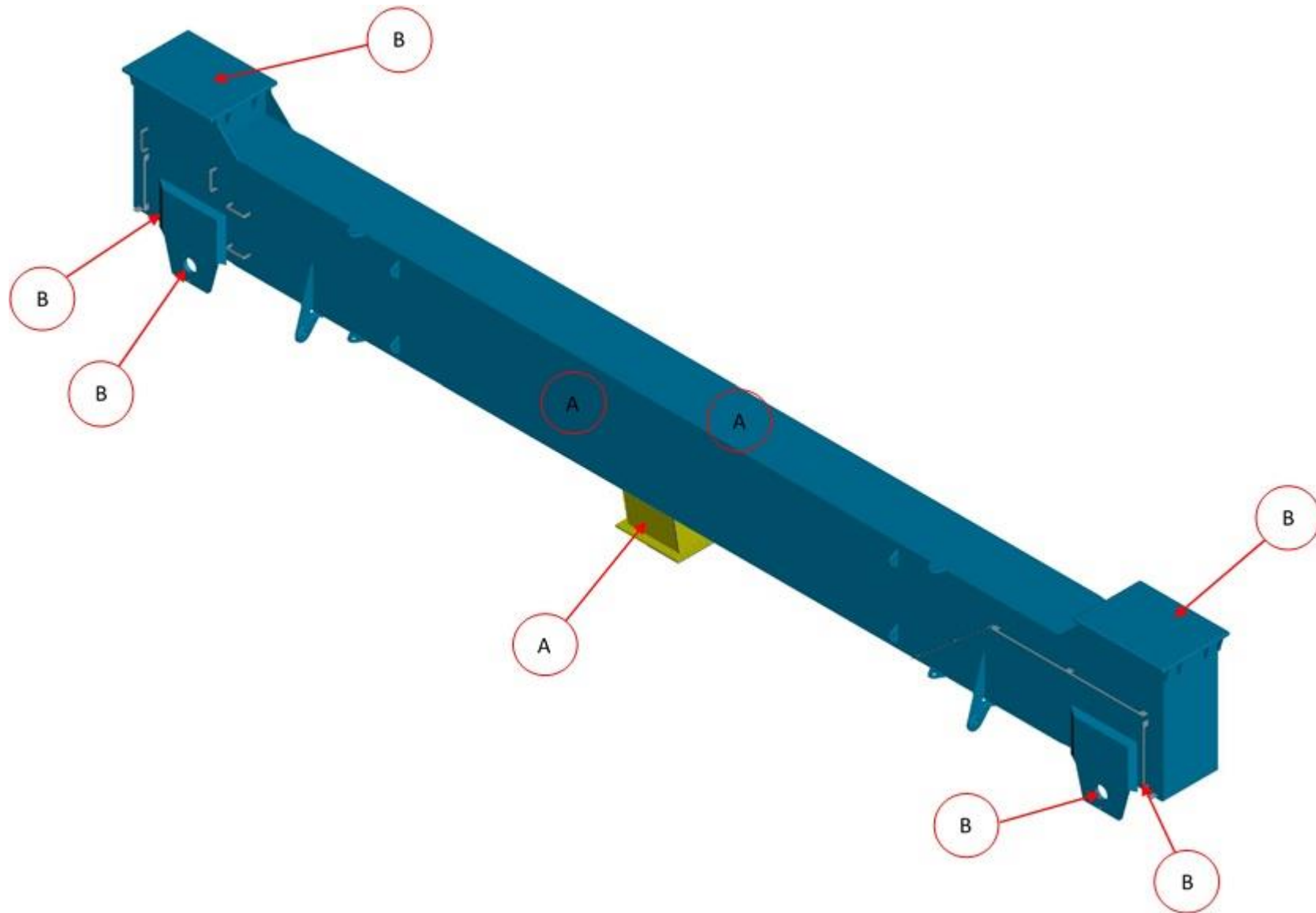


**19.0 END-CARRIAGES – INSTRUCTION**

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Structure (incl. storm pin fabrications) - 3 month inspection from walkways and/or ground level	3 Months 4 Years	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM
B	Examination of the connection to the legs and gantry Rocking Beams - 3 month inspection from walkways and/or ground level	3 Months 4 Years	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM
C	Inspection of the full length - 3 month inspection from walkways and/or ground level	3 Months 4 Years	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM

- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC / UT) shall be used if any areas show potential defects.

**19.1 END-CARRIAGES – INSPECTION POINTS**

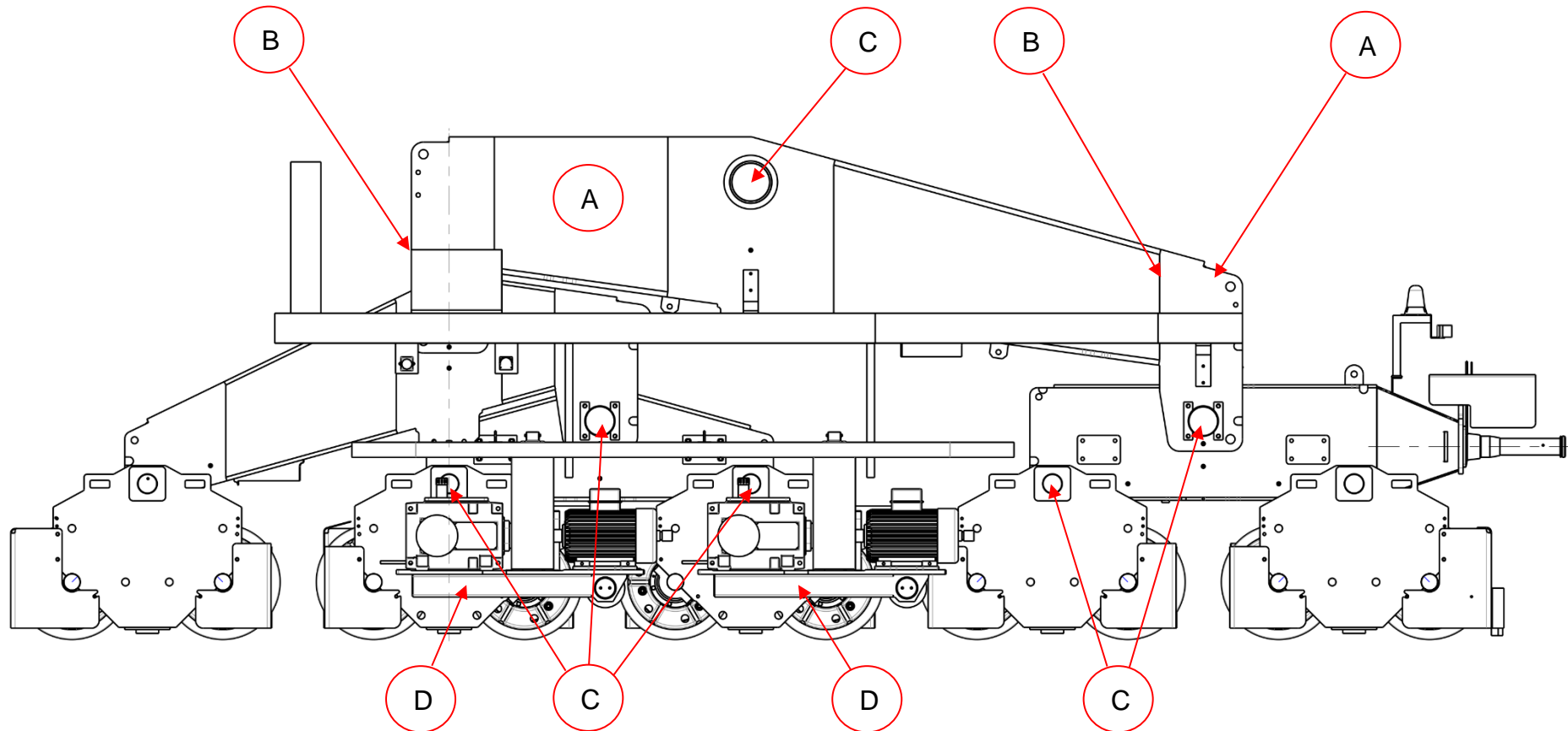


## 20.0 GANTRY TRAVEL ARRANGEMENT - INSTRUCTION

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Examination of the equaliser and bogie fabrications; in particular the corners - 6 month inspection from walkways and/or ground level	6 Months 4 Years	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM
B	Attachment of welded pieces for pivot pins - 6 month inspection from walkways and/or ground level	6 Months 4 Years	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM
C	Bores and pivot pins - 6 month inspection from walkways and/or ground level	6 Months 4 Years	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM
D	Examination of motor and gearbox mounts - 6 month inspection from walkways and/or ground level	6 Months 4 Years	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM

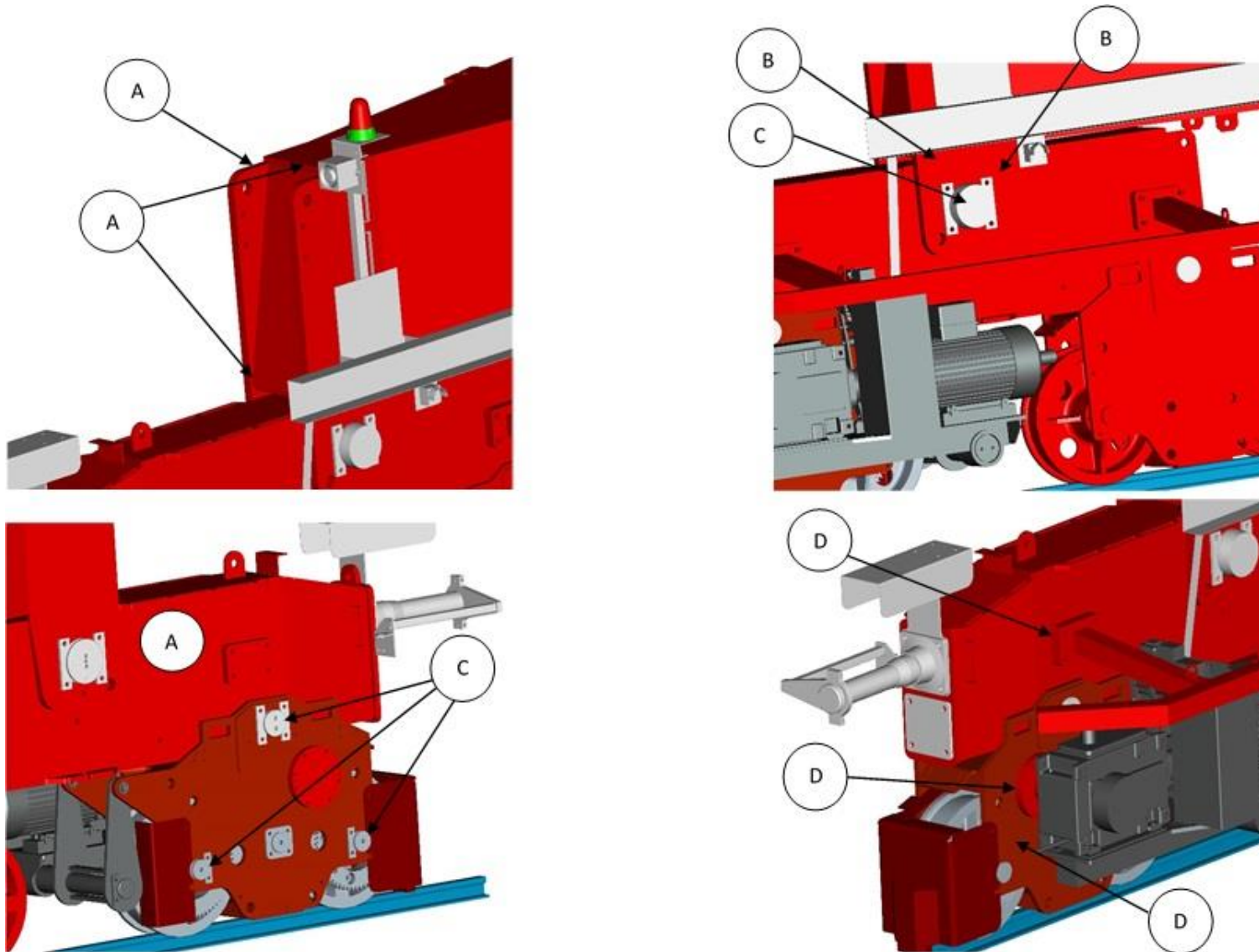
- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC / UT) shall be used if any areas show potential defects.

**20.1 GANTRY TRAVEL ARRANGEMENT – INSPECTION POINTS**





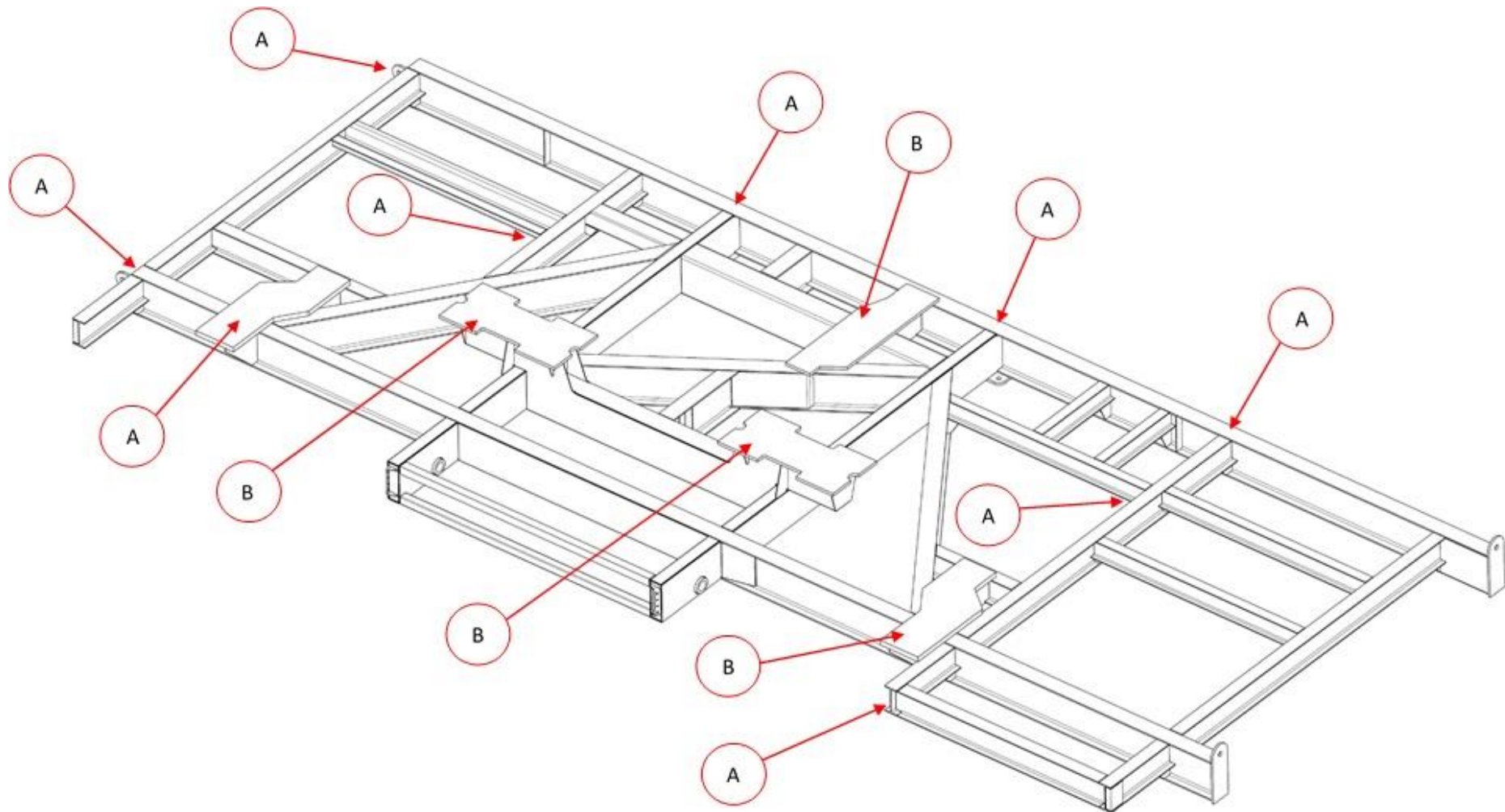
**20.2 GANTRY TRAVEL ARRANGEMENT – INSPECTION POINTS (3D)**



**21.0 MACHINERY HOUSE – INSTRUCTION**

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Examination of the structure from the underside, using the trolley for access. Particular attention paid to joints and members supporting the drums and gearboxes, and areas around connections to Main Beam.	Annual	VT	Competent Person	Thorough Examination	FCM
B	Inspection of the plinths for the motors, gearboxes and brakes, for the hoist and boom hoist.	Annual	VT	Competent Person	Thorough Examination	FCM

**21.1 MACHINERY HOUSE – INSPECTION POINTS**

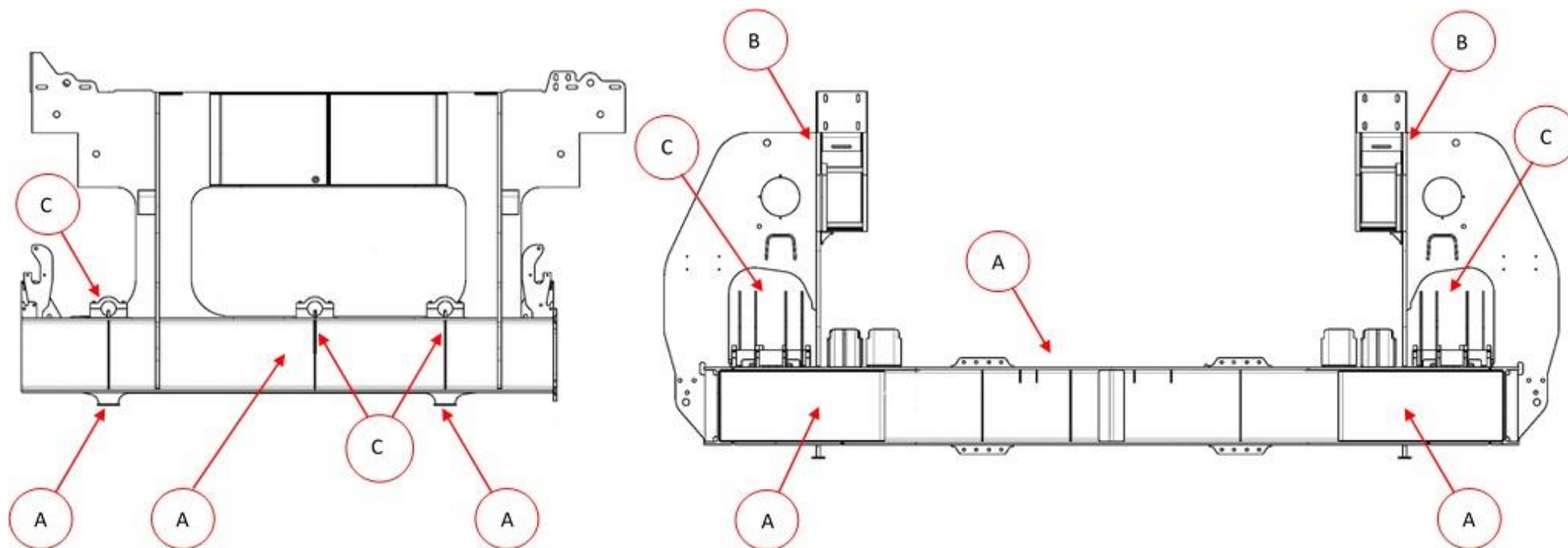


## 22.0 TROLLEY – INSTRUCTION

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Inspection of the trolley top structure, and the platform to the cab.	6 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
B	Examination of the mounts for the trolley wheels and the connection to the trolley.	6 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM
C	Examination of the Hoist sheave mounts	6 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
D	Examine the cab mount arrangement	6 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM

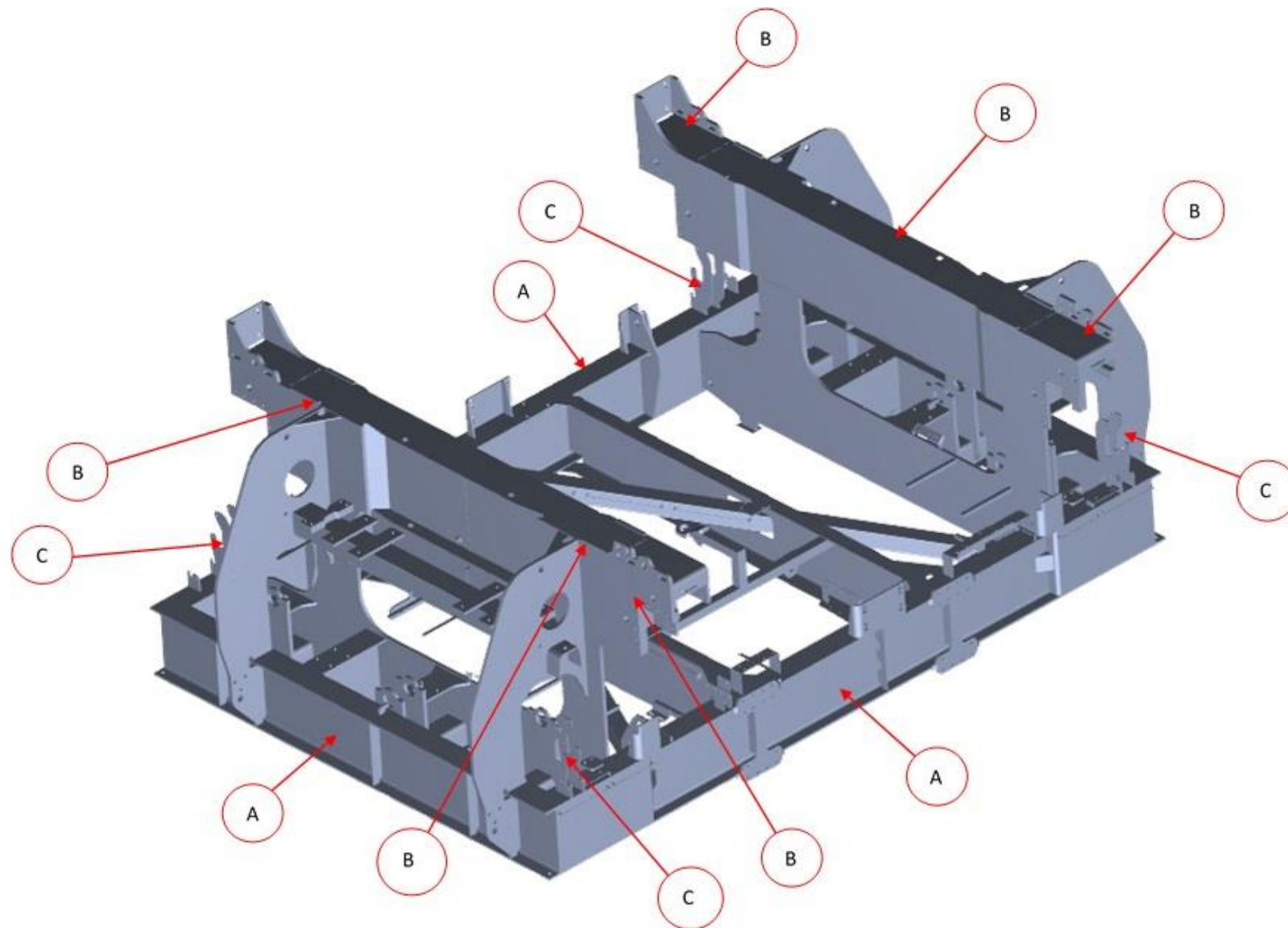
- If some areas are inaccessible or require more detailed examination some added access equipment may be necessary.

**22.1 TROLLEY – INSPECTION POINTS**





**22.2 TROLLEY – INSPECTION POINTS (3D)**

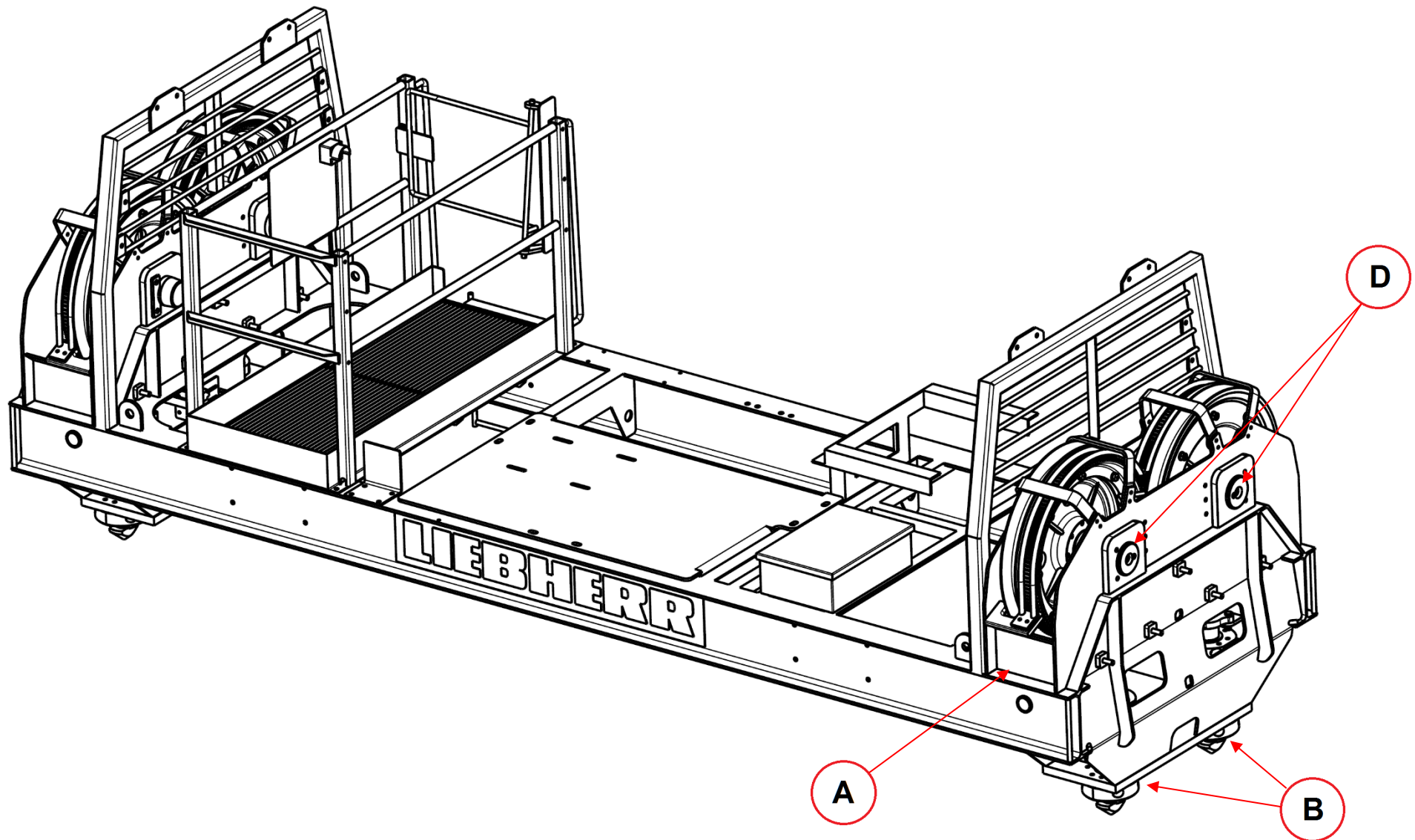


## 23.0 HEADBLOCK - INSTRUCTION

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Examination of the Structure at the ends of the headblocks longitudinal members, in particular the ends of any gussets.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
B	Examination of the end frames, in particular adjacent to the twistlocks	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
C	Inspection around any welded on attachments	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM
D	Inspection of the Sheave pin bores, noting any gaps	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM
E	Inspection of twistlocks	6 Months Annual	VT MT	Competent Person	Thorough Examination Thorough Examination	FCM

- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC / UT) shall be used if any areas show potential defects.

- **HEADBLOCK – INSPECTION POINTS**



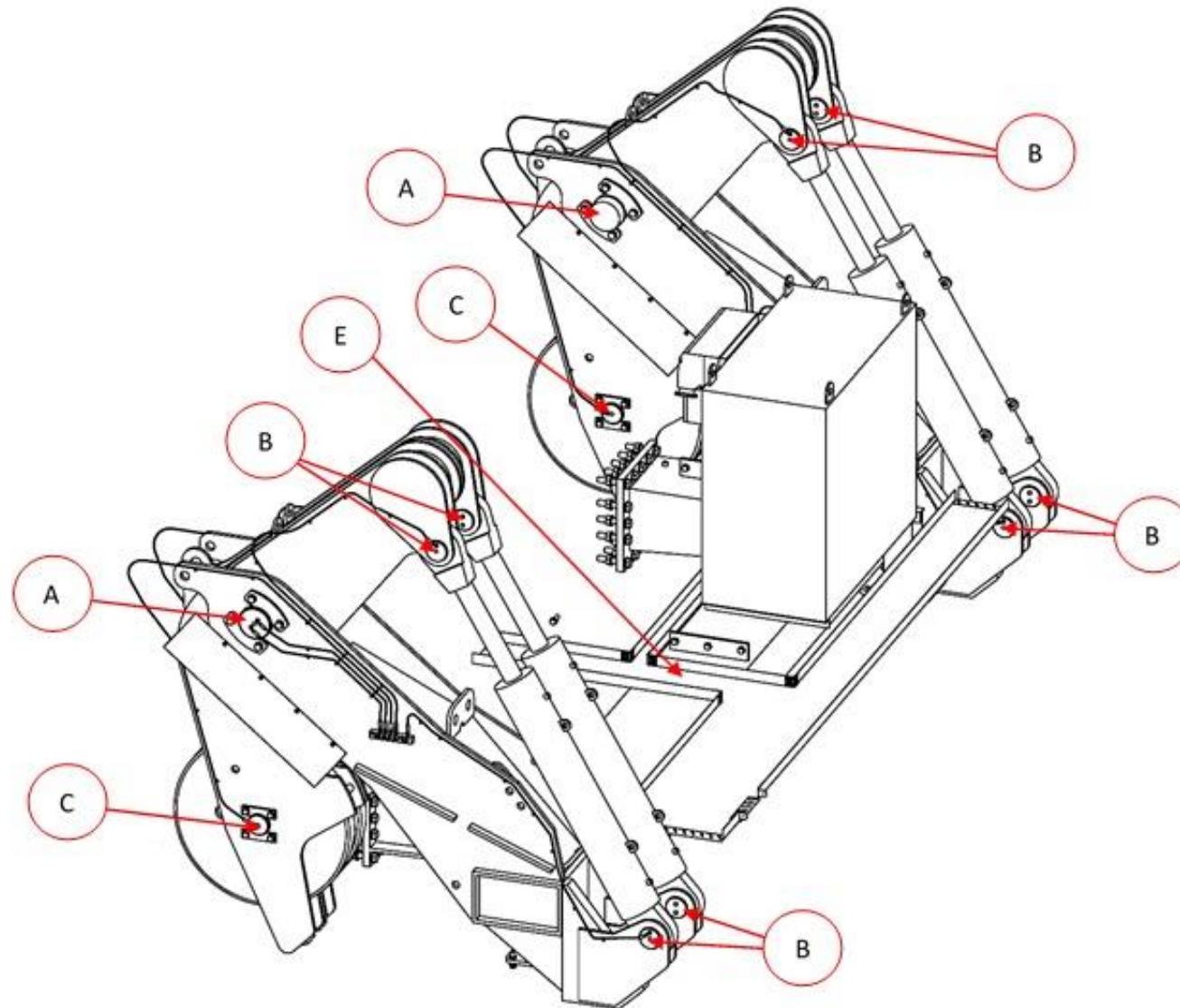


**24.0 TRIM, LIST & SKEW - INSTRUCTION**

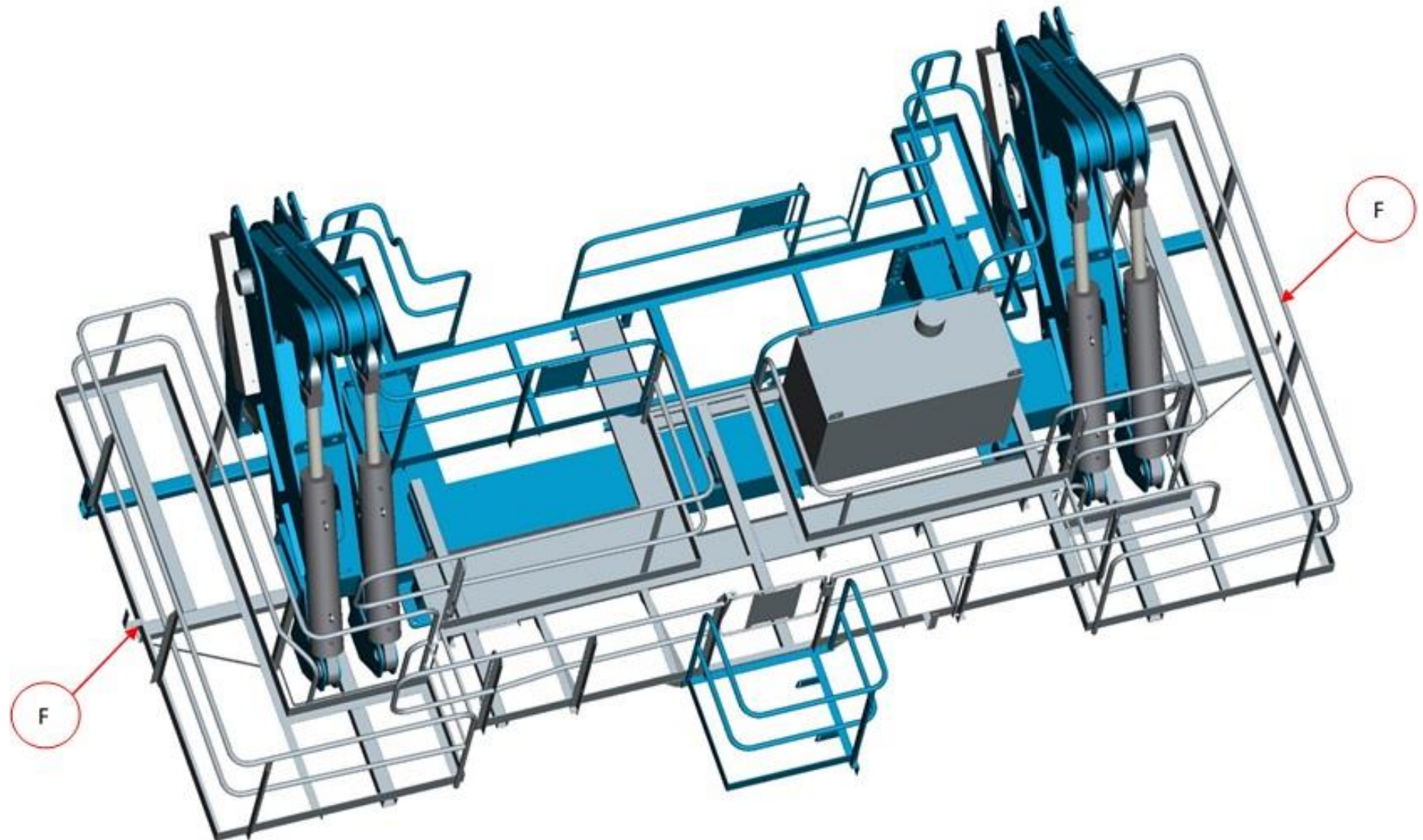
ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Inspection of Pulley Arm pivot pins & bores, noting any gaps.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
B	Inspection of cylinder pins & bores, noting any gaps.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
C	Inspection of the Pulley Sheave pins & bores, noting any gaps.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
D	Inspection of connection flanges to both Platform and Main Beam.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
E	Inspection of supports, particular attention to be paid to welded joints.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
F	Inspection of the platform structure, particularly welded joints.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM

- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC/UT) shall be used if any areas show potential defects.

**24.1 TRIM, LIST & SKEW – INSPECTION POINTS (3D)**



**24.2 TRIM, LIST & SKEW – INSPECTION POINTS (3D)**



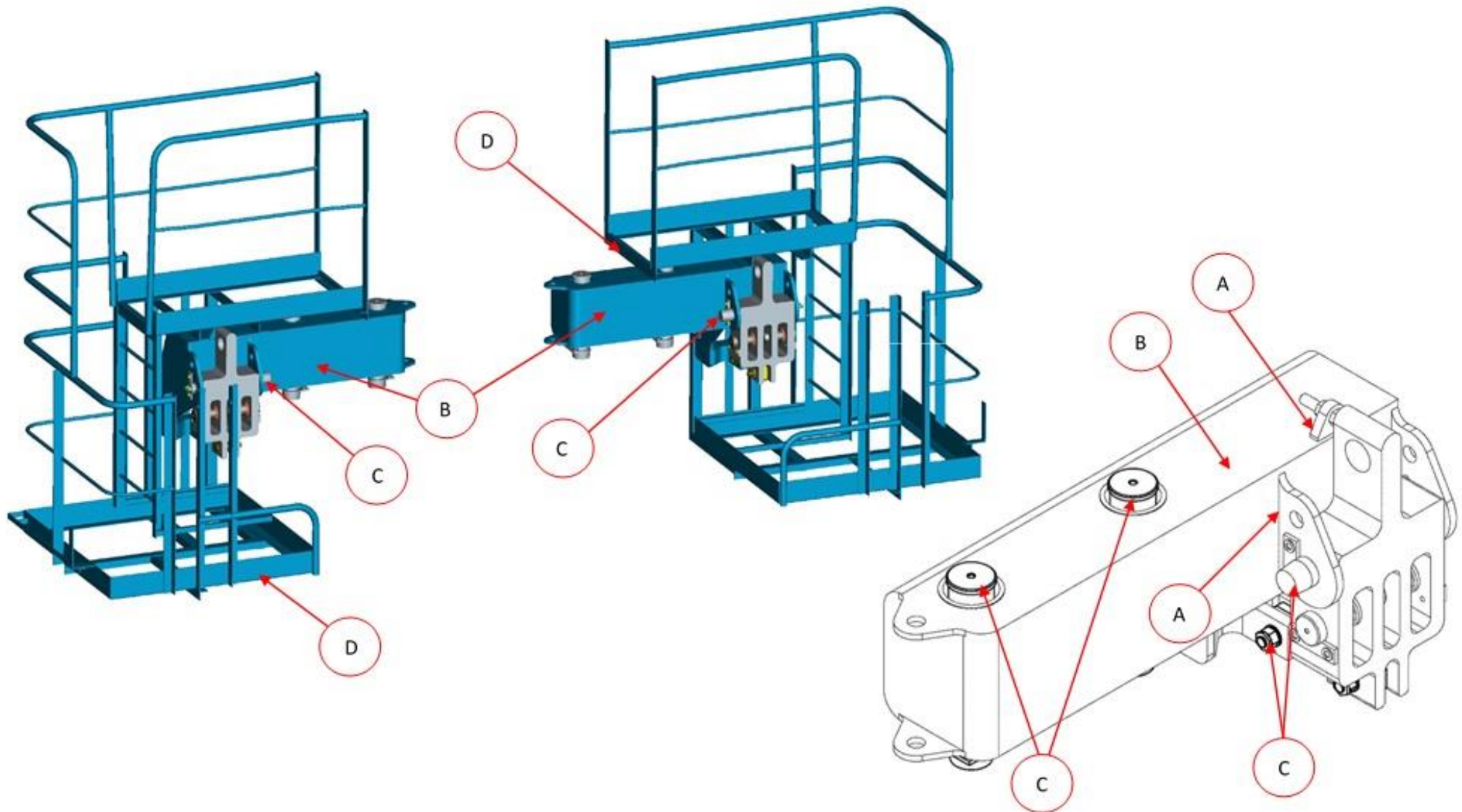
## 25.0 HOIST OVERLOAD SYSTEM - INSTRUCTION

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Visual inspection concentration on any welded joints or attachments.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
B	Visual inspection for the full length, concentration on any welded joints or attachments.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
C	Inspection of the Lever Arm pins & bores, noting any gaps.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	FCM
D	Inspection of frame concentrating on platform connections.	3 Months Annual	VT VT	Competent Person	Planned Maintenance Thorough Examination	NFCM

- Unless otherwise specified inspections shall be visual only, NDT (predominantly EC / UT) shall be used if any areas show potential defects.



**25.1 HOIST OVERLOAD SYSTEM – INSPECTION POINTS (3D)**



## 26.0 BOLTED JOINTS

A random sample of bolts are to be viewed. None are to be removed unless some suspicions or evidence of failure are seen or excessive corrosion.

Generally bolts individually can be considered as non-Failure critical by virtue of the quantity of bolts in a particular joint. However if there are a significant number of damaged bolts in a group then the remainder can become substantially overloaded.

ITEM	DESCRIPTION	INSPECTION PERIOD	INSPECTION TYPE	CARRIED OUT BY	CARRIED OUT DURING	FCM / NFCM
A	Structure					
A1	Bolts will be inspected without dismantling any joints. Corrosion on bolts and nuts will be reviewed for example.	Annual	VT	Competent Person	Thorough Examination	NFCM
A2	From each joint three bolts shall be selected at random for detailed examination.	6 Years	VT	Competent Person	Thorough Examination	NFCM
B	Machinery: Securing bolts shall be checked for security ("tap tested") and for movement during machinery operation. 100% of the bolts in a joint shall be checked by this means.	Annual	VT	Competent Person	Thorough Examination	NFCM

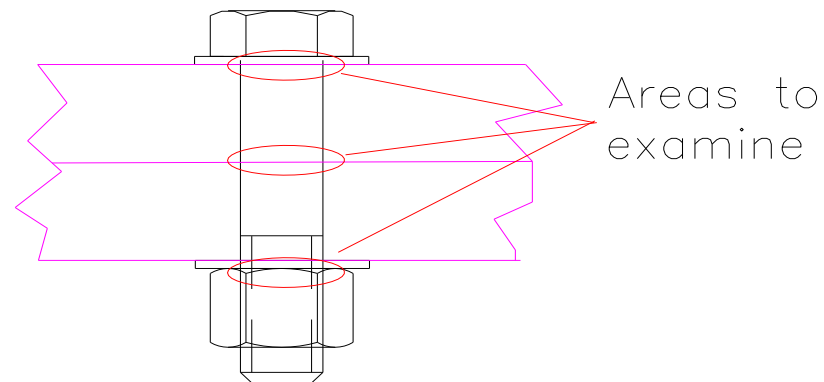
For the Annual inspections, bolts will be externally examined only, from the closest and safest suitable platform. However if defects are suspected, for example lack of tension or corrosion, then the bolts shall be removed. If a defect is found then the adjacent bolts shall be progressively removed until satisfactory bolting is found.

Where bolts are to be removed, if only one bolt is to be taken from a group (ie: being a line of six or more bolts) then the remainder need not be disturbed. However if more than one are taken then the remainder will need attention.

If fractured bolts or bolts with surface cracks are identified at any crane component connection, ALL bolts at this connection must be replaced immediately.

Detailed examination shall include an assessment of the state of corrosion, particularly on the threads and the joint connection face region, and evidence of strain.

Any bolts removed shall be replaced by new bolts of equal strength and grade. The bolts shall be torque tightened to the original specification as defined by the bolt manufacturer and/or Crane designer. In any event, advice shall be sought from a Competent Engineer. Adjacent bolts shall be checked for tightness after the replaced bolt is finish tightened.



## **27.0 SURFACE PROTECTION & CORROSION**

Whilst examining the areas described in the preceding sections an assessment of the paint condition and corrosion shall be made.

Particular areas to inspect are close to welded connections, areas that have had welded attachments added during the crane life, in the vicinity of bolts, and areas where water is likely to collect.

Where the paint appears intact, or only the top coat has become damaged, then no further action is necessary.

Where there is light corrosion (less than 1mm pitting) then the area shall be 'recorded' as needing treatment. This would generally be equivalent to Swedish Standard SS 05 59 00 SA 3.

Where the corrosion appears to be more than 1mm then the record shall show that further investigation is necessary, including ultrasonic material thickness checks, adjacent paint thickness tests and localised material removal. The extent of the further work shall be at the discretion of the Competent Engineer.

Whenever repainting and/or 'touch up' painting is performed (whether by internal or external persons) the paint procedure specific to this crane shall be strictly adhered to.