

SECTION- S.16
Precast U-Girder and related items**16.1 PURPOSE**

This Specification is Applicable for

- a. Precast Pier cap with cast-in-situ stitch concrete.
- b. U girder Type Superstructure.
- c. Deleted
- d. Launching of I Girder.

The specifications for the same are being provided herewith

16.2 U-GIRDER AND PRECAST PIER CAP**16.2.1 Pre-cast Pier cap**

Construction Methods

STAGE-1

- Fabrication of Pier Cap at Casting Yard.
- Recess hole is provided at center of pier cap along with in-situ connection with pier.
- Reinforcement bars are folded around recess hole for future connection with pier.

STAGE-2

- Transport of Precast pier cap to site.
- Lifting of pier cap to top of pier by means of lifting cranes.
- Adjustment devices may be required for correct adjustment of pier cap on pier head. These steel devices are fixed to pier head and pier cap shaft.
- Adjustment the Line, Level and Align the Pier cap as per Drawings.

STAGE-3

- Installation of PT duct through hole and U-Bars inside hole and through Rebar cage.
- Pouring of concrete in recess hole for integral connection between pier and pier cap.

STAGE-4

- Removal of adjustment device.
- After in-situ concrete has reached sufficient strength, stressing of first Stage PT and grouting.
- Plugging of lifting holes before installation of u-girder

STAGE-5

- Installation of superstructure by crane or launcher and then
- Second stage of PT will be done and grouted.
- Concreting of PT anchorage recesses

16.2.2 U - Girder**STAGE-1**

- Fabrication of U Girder at Casting Yard.

STAGE-2

- Transport of U Girder to site.
- Lifting of U Girder to top of pier by means of lifting cranes I or by Launching Girder.

- Placing of U Girder on the temporary supports and adjust the Line and Level.

STAGE-3

- Cast the Shear Key.

STAGE-4

- Place the Bearings both Horizontal and Vertical.
- Lower the U Girder and secure it.

STAGE-5

- Install all the Drainage accessories and waterproof Expansion joint.
- Hand over to Track People.

16.2.3 Shop Drawings and Design Calculations for Construction Procedures

16.2.3.1 General

The Contractor shall submit according to a schedule, complete details and information concerning the method, materials, equipment and procedures he proposes to use. These shall be called "Method Statements". Method Statements shall be submitted sufficiently in advance of the start of superstructure field construction operations, so as to allow the Engineer adequate review period. The submittals shall invariably include step-by-step erection procedure. The Contractor's Method Statements shall also include all calculations, drawings and information as may be relevant.

16.2.3.2 Design Calculations and Construction Procedures

Design assumptions and calculations shall be submitted for temporary prestressing, false work, erection devices, formwork or other temporary construction which may be required to complete the work. Assumptions and Calculations shall also be submitted to substantiate the system and method of permanent and temporary prestressing proposed by the Contractor.

16.2.4 Casting, Stacking, Handling, Transportation and Erection of Girder

16.2.4.1 General

The Contractor shall submit detailed Method Statements for casting, handling, transportation and erection of girder. The superstructure shall be erected by the method indicated in the tender or by alternate method submitted by the Contractor, subject to the approval of the Engineer. The stressing system, cage of reinforcement and lifting details shall be successfully demonstrated on sample segment prior to casting any permanent segments.

All handling and erection plant and equipment shall be load tested prior to their use at site or when specifically asked for by the Engineer. Any additional material required to cater to any temporary condition including temporary prestressing shall be borne by contractor and nothing extra will be paid in this account.

16.2.4.2 Casting

Casting bed and forms shall be structurally adequate to support the girders without settlement or distortion. The casting bed shall be designed for the hardware needed to adjust and maintain grade and alignment. Special consideration shall be given to those parts of the forms that have to change in dimensions. To facilitate alignment or adjustment, special equipment such as wedges, screws or hydraulic jacks shall be provided. Fittings shall not interfere with stripping of forms. External vibrators shall supplement the internal vibration

if necessary and be attached at locations that will ensure maximum consolidation.

Details for casting bed and hardware for adjustment shall be submitted by the Contractor for the Engineer's approval. Casting of girders shall be done in a single pour. Construction joint is not permitted in girder.

Care shall be taken to ensure that deformations due to thermal gradients caused by the heat of hydration of the new cast concrete are negligible. These deformations shall be prevented by properly protecting with curing blankets and plastic sheeting. Reinforcing steel shall be fabricated in cages and placed according to the Execution Drawing issued by concerned organization. Any conflict or interference with the proper location of reinforcement or block-outs shall be promptly resolved and corrections made as directed by the Engineer/Engineer's Representative. All girders shall be marked on the inside with a unique identification at the time of form removal.

16.2.4.3 Stacking

Stacking of Girders or Precast Units shall be done as per Approved Drawing and as per Available Layout in the Casting Yard.

16.2.4.4 Handling | Erection of Girders

The Contractor shall be responsible for the proper handling, lifting, storing, transporting and erection of all girders so that they may be placed in the structure without damage. Only HTS bar shall be used for lifting/handling of girder at any stage of construction, with due care for fatigue considerations (multiple re-use).

Girders shall always be maintained in an upright position and shall be stored, lifted and/or moved in a manner to prevent torsion and differential deformation other undue stress. Members shall be lifted, hoisted or stored with lifting devices approved on the shop drawings.

The Contractor shall furnish calculations to establish that the stresses induced during any stages of construction shall not exceed 50% of the cube strength achieved at that stage, nor 40% of the specified 28days cube strength. In addition, the following limitations shall be observed:

The girder shall not be lifted from the casting bed till the concrete reaches a minimum cylindrical strength of 25 MPa (or 30MPa Cube strength).

The age of the concrete shall not be less than 28 days at the time of its erection provided it has achieved its specified strength as per design requirements.

Girders shall be stacked with three-point support in curing tank / stacking yard as shown in tender drawing, or as approved by concerned organization Curing shall be done using sprinkler system (assisted by steam curing in the initial stages if adopted) and it has to be ensured that all parts of girder are water cured during water curing period. Curing compound as per relevant specifications may be applied after approval of Engineer-In-Charge

16.2.4.5 Cleaning of Girders

Before transportation of girder, surface shall be cleaned by water rinsing or sand blasting as approved by the Engineer.

16.2.4.6 Miscellaneous

The entire construction work shall be geared towards minimizing disruptions to road traffic. Also, the occupation of roads during all construction activities shall be reduced to a minimum and subject to the approval of the Engineer. Reinforcement shall be fabricated in cages in casting yard for piles, pile caps and piers before being brought into position for expediting the activities.

All elements of sub-structure below bearing pedestals viz piles, pile caps, piers and pier caps shall each be cast in single pour.

16.2.4.7 Load Testing of Standard Span of Superstructure

The contractor shall conduct full scale load test for one Girder (simply supported span, erected in position, including arrangements for applications of serviceable vertical load for measuring deflections and rotations and submit the report).

The sequence of placement and position of loading on the girder shall be as directed by the engineer.

16.2.5 Overhead Gantry Specifications for U Girder

16.2.5.1 Nomenclature

The following terms and abbreviations are used in this report: LG Launching Gantry or Erection Gantry

MT	Main Truss
UCB	Upper Cross Beam
LB	Lifting Beam
CB	Connection Beam
(F/R)RS	(Front/Rear) Roller Support (F/R)LCB
(Front/Rear) Lower Cross Beam LSF	Lower Support Frame
F/RSL	Front/Rear Support Leg
Stress bar	Threaded stress bar
LSJ	Long Stroke Jack Long Longitudinal
Trans.	Transverse
Ecc.	Eccentricity
-NA-	Information Not Available
EJ	Expansion Joint
TBA	To Be Advised

16.2.5.2 Structural design codes & load factors

The design of the gantry shall be based on a limit state design approach. The design codes used for the structural design of steelwork include the following:

- (a) IS800 or any other suitable international code of practice.
- (b) The load combinations, load factors and material resistance factors will be appropriate for each of the design code(s).

16.2.5.3 Stability factors of safety

For all possible scenarios of operation, the factor of safety for stability shall be established. However, for certain controlled conditions, a reduction in the required factor of safety against instability can be considered, provided that the potential risks are assessed, and it is deemed sufficiently safe. However, the factor of safety against overturning should not be less than 1.2.

16.2.5.4 Friction Factors

The following friction factors shall be assumed:

- a) Crane wheels (adverse): 1.0%
- b) Lateral guide wheels and flanges of crane wheels (adverse): included above
- c) Crane wheels (beneficial): zero
- d) Lateral guide wheels (beneficial): zero
- e) Teflon/stainless steel (adverse): 5%
- f) Teflon/stainless steel (beneficial): zero
- g) Ecotex (Nylatron)/stainless steel (adverse): 10%
- h) Ecotex (Nylatron)/stainless steel (beneficial): 5%
- i) Brass (or bronze)/steel – greased (adverse): 20%
- j) Brass (or bronze)/steel – greased (beneficial): 5%
- k) Steel/steel – greased (adverse): 30
- l) Steel/steel – greased (beneficial): 5%

16.2.5.5 Dynamic factors & launching forces

a) Stationary MT

The following dynamic factors are to be used for consideration of moving loads when the MT is stationary:

- Vertical - 15% of moving loads
- Parallel to movement direction - 5% of moving load
- Perpendicular to movement direction - 3% of moving loads

b) Moving MT

i. Dynamic factors

The following dynamic factors are to be used for consideration of MT launching and movement:

- Vertical - 10% of moving loads
- Parallel to movement direction - 5% of moving loads
- Perpendicular to movement direction - 3% of moving loads

ii. Launching forces for equipment

For consideration of longitudinal forces on hydraulic jacks during launching of the MT, the force is derived considering longitudinal gradient and friction.

iii. Launching forces for structure

For consideration of longitudinal forces on the Roller support during launching of the MT, the force is derived considering longitudinal gradient and friction.

c) Moving UCB/FSL/RSL

i. Dynamic factors

The following dynamic factors are to be used for consideration of UCB/FSL/RSL movement:

- Vertical - 10% of moving loads
- Parallel to movement direction - 5% of moving loads

- Perpendicular to movement direction - 3% of moving loads
- ii. Launching forces for equipment
For consideration of longitudinal forces on chain blocks or other moving devices during launching of the UCB/FSL/RSL, the force shall be calculated considering longitudinal gradient and friction.
- iii. Launching forces for structure
For consideration of longitudinal forces on the MT/UCB/FSL/RSL during launching of the UCB / FSL / RSL, the force shall be calculated considering longitudinal gradient and friction.
- iv. Longitudinal fixity
During span erection shall have a longitudinal fixity with Roller support and shall be considered in design and stability of system.

16.2.5.6 Wind loading

All wind speeds referred beneath are based on gust speed.

In service wind (with span erection) S 20 m/s Gantry launching wind load S 15m/s Tropical storm wind (with span erection) S 42m/s

Tropical storm is normally with advance warning and hence it is deemed to be possible that span under erection shall be completed and load transfer onto span jack prior to arrival of storm. Effect of gantry stability under self- weight only should be evaluated without any segment suspended and additional tie down system is to be provided if necessary. The Above Wind Speeds May be suitably modified for Site Specific Winds. Two types of wind loading shall be considered:

- In-service wind loading: wind while handling of span (lifting, lowering, etc.)
- Out-of-service wind loading: Typhoon wind loading

16.2.5.7 Height Restriction

The gantry must cross few exiting structures. The height of top of main truss above pier cap top shall be limited to 6500mm.

16.2.5.8 Minimum Horizontal Radius

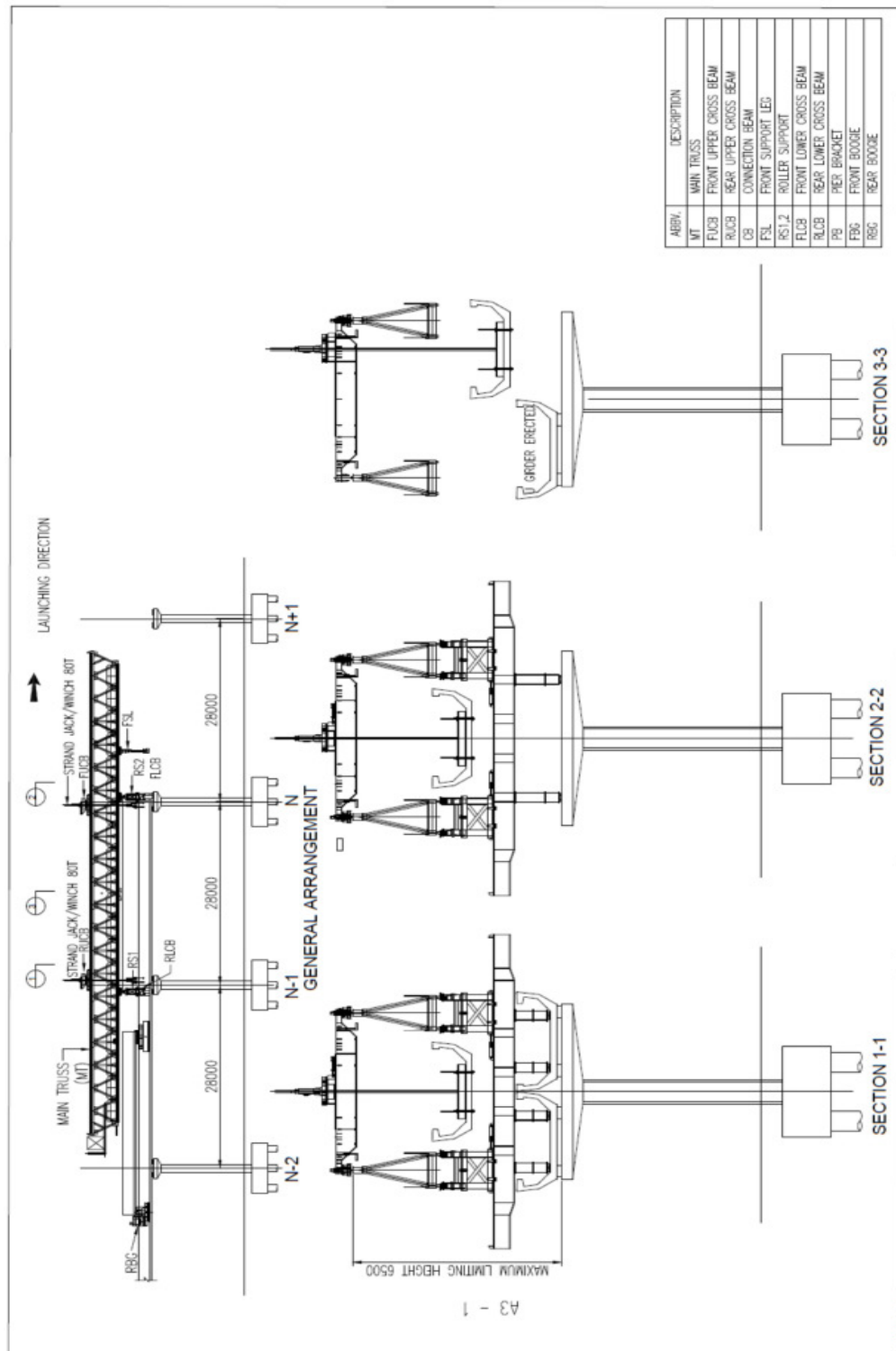
The gantry shall have adequate functional and structural provisions to launch over spans with 200m horizontal radius.

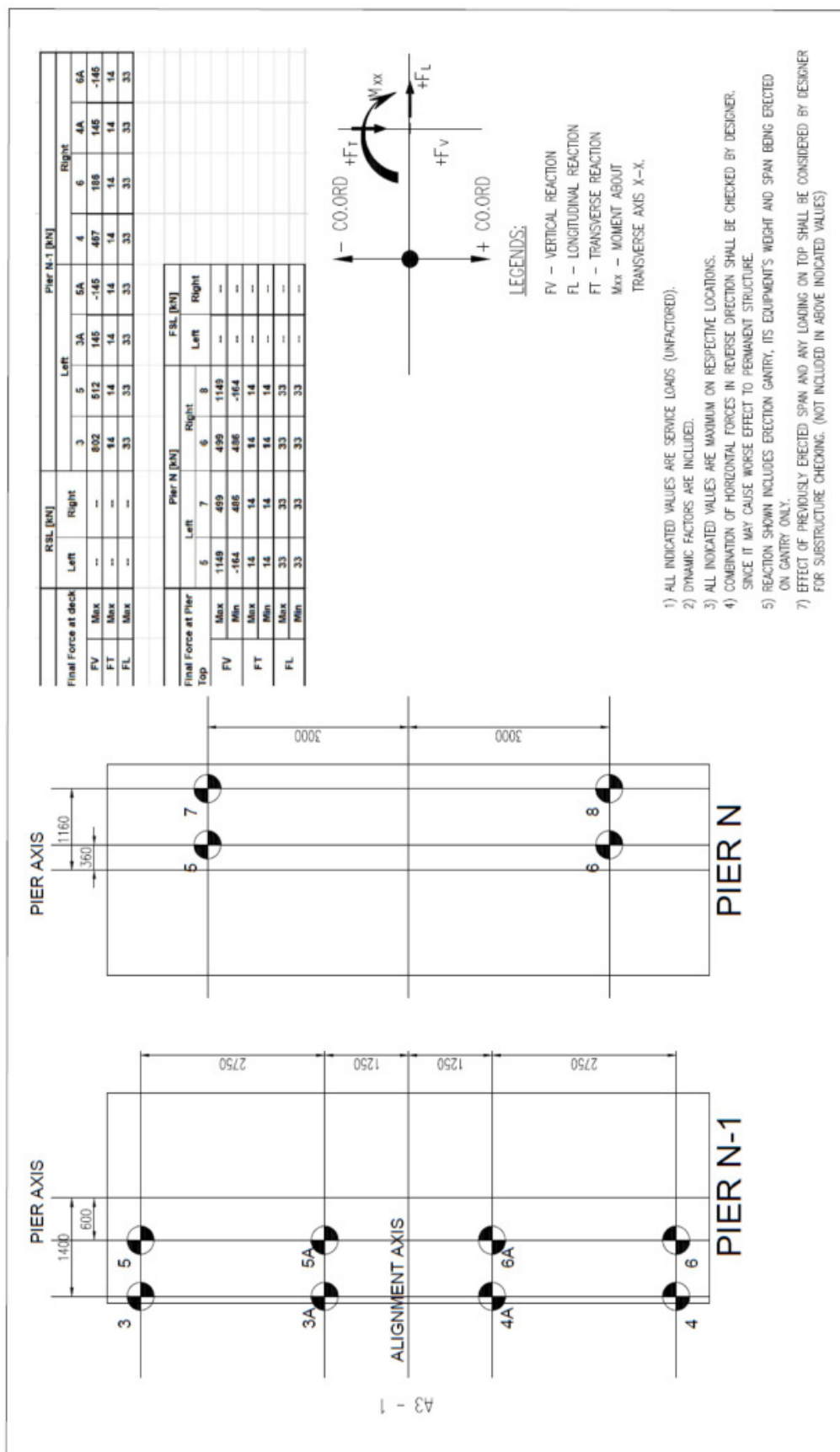
16.2.5.9 Reaction on Piers

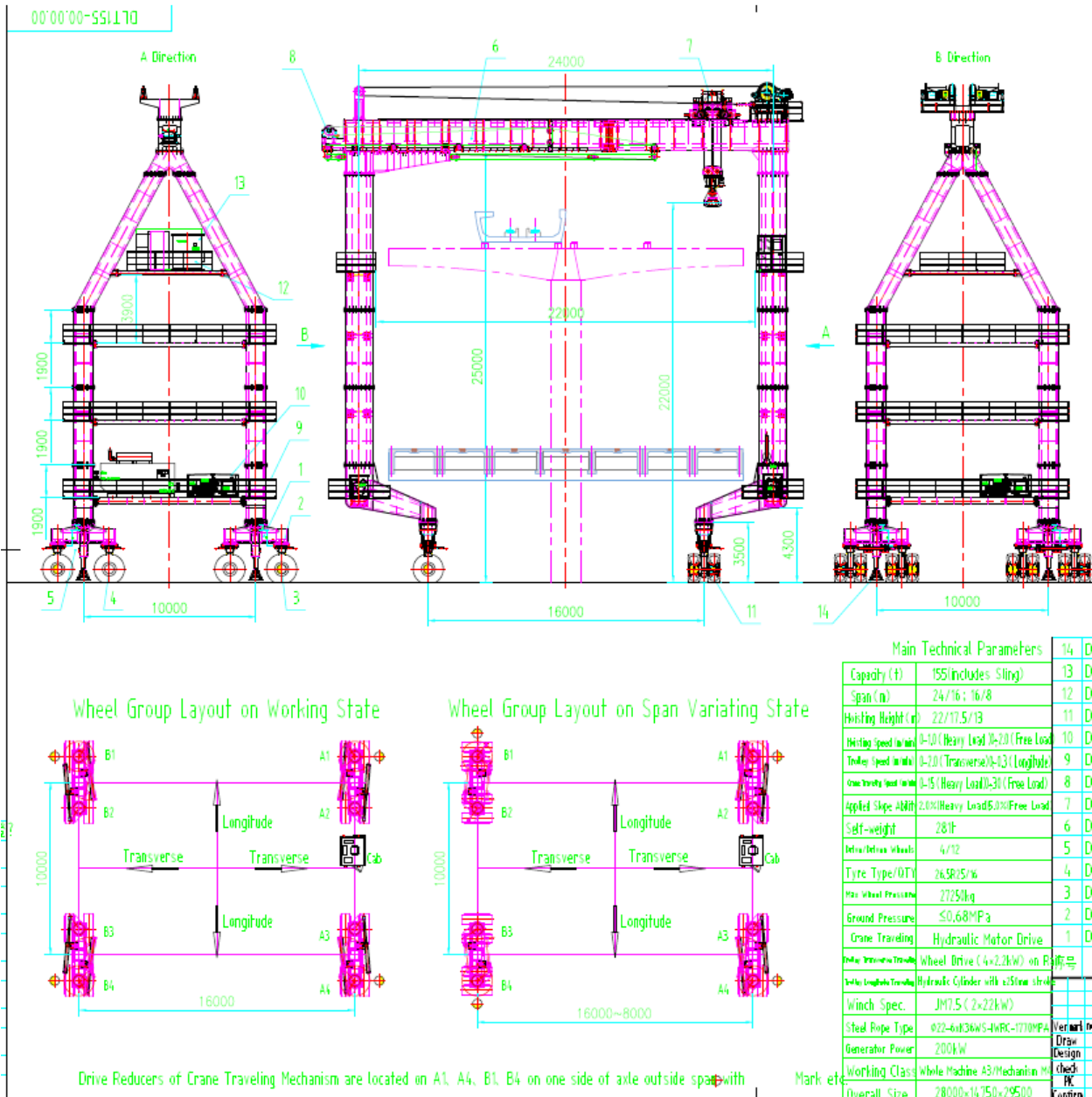
The reaction on pier top due to operation of erection gantry, shall be limited to followings:

		RSL [kN]		Pier N-1 [kN]							
Final Force at deck		Left	Right	Left				Right			
				3	5	3A	5A	4	6	4A	6A
FV	Max	--	--	802	512	145	-145	467	186	145	-145
FT	Max	--	--	14	14	14	14	14	14	14	14
FL	Max	--	--	33	33	33	33	33	33	33	33
		Pier N [kN]				FSL [kN]					
Final Force at Pier Top		Left		Right		Left	Right				
		5	7	6	8						
FV	Max	1149	499	499	1149	--	--				
	Min	-164	486	486	-164	--	--				
FT	Max	14	14	14	14	--	--				
	Min	14	14	14	14	--	--				
FL	Max	33	33	33	33	--	--				
	Min	33	33	33	33	--	--				

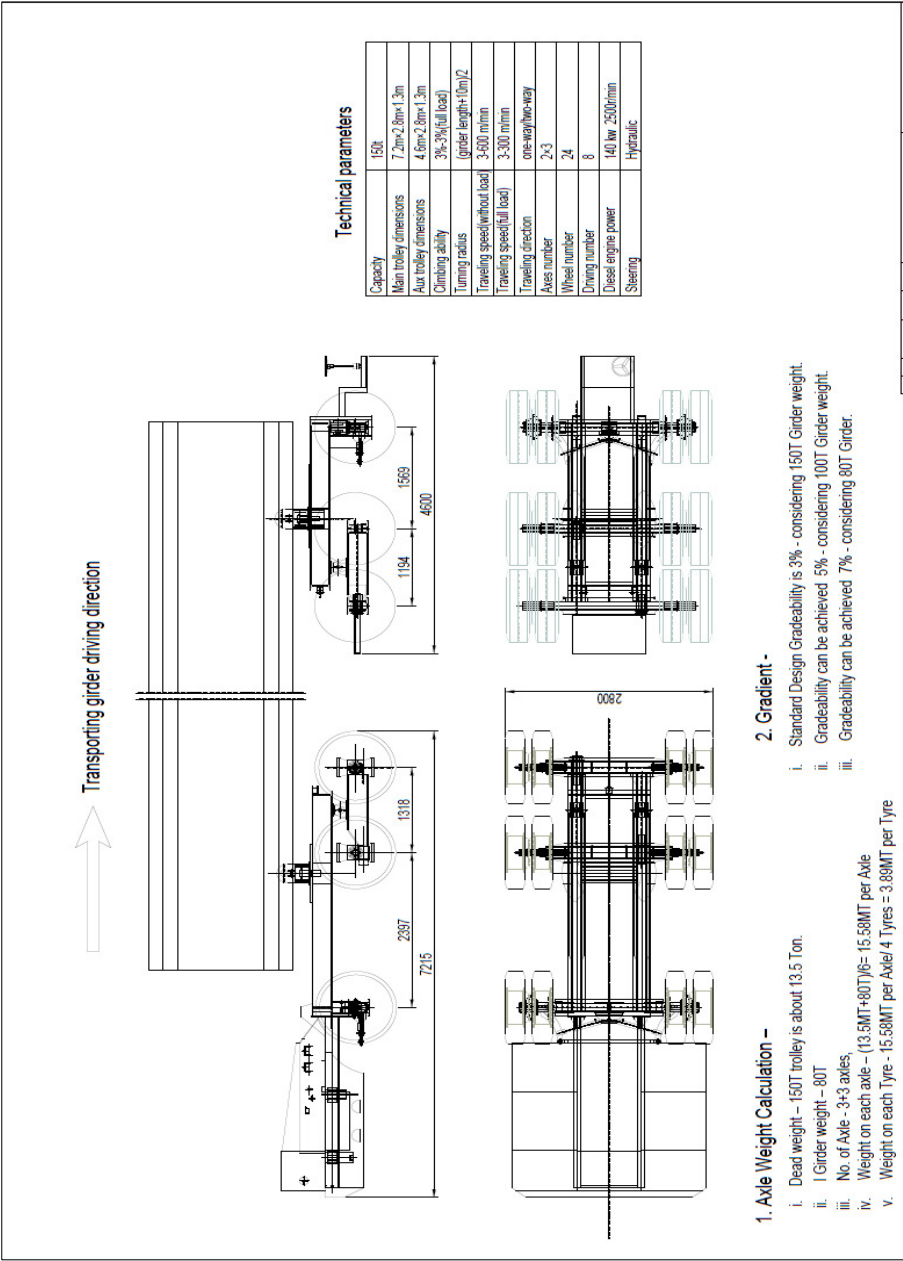
For nomenclature and location of reaction point definition refer to following drawings: -







SKETCH SHOWING DETAILS OF STRADLE CARRIER SUITABLE FOR STATION GIRDER LAUNCHING



16.2.5.10 Transfer Boogie

The U Girder shall be transported with two numbers of motorized bogies. The Weight of each bogey, inclusive of all equipment, shall be limited to 5.5 t.

S. Nr	Item	Specification
1	Max Weight of each boggy	5.5 t
2	Max Speed (Loaded condition)	2 Km/hr
3	Max Speed (Unloaded condition)	3 Km/hr
4	Maximum gradient	4%

16.5.2.11 Specification on Safety

a) Illumination

A lighting system for working area shall be provided to improve visibility in case of scarce daylight. Anyway, personnel responsible of safety must make sure that there is a good visibility of every point, not be create dangerous reflex and allow a clear reading of control boards and identification of emergency push buttons.

b) Controls

Operating any control that creates a sharp variation in drive direction, such as halting the winch by engaging the opposite movement, is forbidden. The stresses which may arise are uncontrollable and may seriously damage the equipment, causing personnel and material risk. Such controls may be operated in the event of an imminent danger to persons.

c) Safety devices

The GANTRY shall be provided with electrical and mechanical devices which reduce the danger that may occur during working phases. The safety devices are in various points of the launching machine and can be listed as follows:

➤ Protected walkways, ladders and platforms

Main walkways, placed inside the two trusses, allow safe access to working areas and all control units of supports, legs, winches, cranes. In order to reach walkways and platforms, protected ladders are mounted on both legs and supports.

➤ Limit switches

Electrical limit switches shall be installed on moving parts of the gantry. If actuated, they stop the related movement before mechanical stops are reached.

➤ Over speed detection system

A safety system that monitors operating speed and stops the machinery in case of over speed shall be installed on winch drums.

➤ Inclination detectors

Electrical inclination detectors shall be installed on the winch drums.

➤ Load cells

Gantry shall be equipped with load cells in order to constantly survey load conditions.

➤ Emergency push buttons

Emergency push buttons shall be installed in the gantry. If actuated by operators, they stop immediately all running movements.

- **Safety braking system**
Safety braking system shall be installed to stop the rope drum in case of failure of the control drive, motor, service brake or gearbox.
- **Encoders**
Lifting and lowering stroke shall be defined by an encoder mounted on each hoisting winch drum connected with a limit switch.
- **Digital speed gauges**
Speed gauge shall be mounted on each hoisting winch drum to continuously check for rope over speed.
- **Max relief hydraulic valve**
Each hydraulic motor shall be equipped with a hydraulic valve to limit oil pressure in the circuits.
- **Hydraulic pressure switch**
Winches hydraulic circuit shall be equipped with a hydraulic switch to control lifting pressure.

16.3 Technical Specification for Steel Plates (Placed in between in between bearing and bottom of girder).

16.3.1 General

- i. This specification covers requirement for Carbon Steel Plates of Structural Quality as per IS:2062 Gr. E 250-B (as a minimum requirement) intended primarily for steel plates in contact with bearing and bottom of girder.
- ii. Plates shall conform to IS: 2062 Grade E250-B-as a minimum requirement and to this technical specification. Reference shall be made to IS: 2062 wherever applicable.
- iii. Steel Plates manufactured by steel makers only will be accepted. Plates rolled from slabs that are sourced from Third parties will not be accepted. Plates supplied to this specification shall conform to IS:2062 with additional requirement mentioned herein.
- iv. The plate shall be free from surface flows, laminations and any other harmful defects.
- v. The tolerance for plate thickness, width and length shall be ZERO in negative side and the tolerance for plate thickness, width and length on the positive side shall be in line with the tolerance limit(s) specified in the latest issue of IS:2062 in accordance with IS 1852 - latest edition.
- vi. The plates shall be free from injuries and defect and shall have workmanlike finish.
- vii. Reconditioning/ repair of plates by welding is not permitted.

16.3.2 Plates shall comply with Chemical composition as per table 1 of IS:2062.

Plates shall have following Mechanical Properties. Plates conforming to all the specifications of E-250-B quality as per

a)	IS:2062. Yield Strength	250 MPa Minimum
b)	Tensile Strength	410 MPa
c)	Elongation	23% min.
d)	Bend Test	2t for less than or equal to 25mm thick product, 3t for less than 25mm thick product.
e)	Charpy Test	applicable for E-250-B quality & thickness of 12mm & above.

	Table 2 of IS: 2062 may be referred for full details.
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16.3.3 Supplementary Technical Requirements:

The contractor shall produce manufacture certificate of Chemical composition and Mechanical Properties in accordance with IS: 2062 Additionally, inspection reports for dimensional checks and surface conditions shall be furnished for confirmation that the plates are dimensionally acceptable and free from surface flows, laminations and any other harmful defects.

Measurement

Measurement shall be made for the finished volume of reinforced cement concrete (excluding lean concrete) only. All linear dimensions shall be measured correct to 1cm & restricted to design dimensions, and the volume calculation will be correct to two decimal places in cubic meters.

No deduction shall be made for volume of steel embedded in concrete or for voids not exceeding 0.03 cum in volume.

The measurement for prestressing steel wires shall be made on the actual length of wires from end to end of cut-face of anchorages for post tensioned concrete as per the profile drawing and shall not include the extra length of wires at both ends. For pretensioned concrete the measurements of high tensile steel wires shall be measured from end to end of concrete faces and shall not include extra length of wires at both ends. The quoted Lumpsum Price for high tensile steel work shall include formation of cables in position including cost of spacers, transporting, anchorages, sheathing, grouting, stressing and all other relevant work including staging etc.