LATTICE TOWER ERECTION MANUAL

A. HSE Requirements

Safety in this erection procedure is paramount. All erection personnel, shall, while on site or working, wear the following standard safety Personal Protective Equipment:

1. Safety Shoes – Fibre Safety Toe
2. Safety Glasses
3. Safety Helmet
4. High Visibility Vest
5. Safety Harness with Lanyard
6. Safety Belt with Tool Holders
7. Gloves
8. Dust Masks and Ear Plugs where required

B. Tools & Tackles

As a general guide, the following Tools and Tackles shall be available with the erection crew.

1. Nylon Ropes 14/16 mm diameter – 200 meter
2. D Shackles
3. Torque Wrench
4. Spud Wrench
5. Power Hand Drill
6. Power Hand Grinder
7. Hex Head Sockets
8. Chain Hoist
9. Nylon Lifting Straps and Nylon Rope Slings

C. Pre-Erection Preparations

Prior to commencement of Tower Erection, the following preparatory checks are required:

a. **Equipment Readiness:** Check, verify and validate
   i. Maintenance Record of Lifting Equipment
   ii. Fitness Certificate of Lifting Equipment
   iii. Certifications for Equipment Operators
   iv. Statutory Compliances – Taxes, Licenses, Permits

b. **Tool Readiness:** Check, verify and validate
   i. Load Test on Ropes, Shackles, Hoists, Lifting Straps, Wire Slings
   ii. Integrity of Power Cords
   iii. Calibration report of Tapes, Torque Wrenches, precision measuring equipment
   iv. Properly maintained Power Tools and electrical cords

c. **Manpower Readiness:** Check, verify and validate
   i. Identity of each worker
   ii. Medical Fitness Certificate including Vision and Hearing Test Reports
   iii. Rigger Certification, Work-at-Height Certification, Weld Certification
   iv. Erector Training, Crane Hand Sign Training

d. **Material Management:** Tower Material at site should be segregated by Tower Panel and then by section size within the Panel, going from bottom to top of Tower. Member Mark Numbers should be

clearly identified. All Material should be placed on wooden dunnage and direct contact with soil/dirt must be avoided. All materials should be checked off against the Tower BOM supplied by the manufacturer and any missing parts and components should be immediately identified and reported. Copies of Bill of Materials and General Assembly Drawings together with Material Packing and Shipping manifest should be available on site.

D. PREPARATION FOR TOWER ERECTION

a. The tower foundation must be back filled before starting any tower erection.
b. The foundation concrete must have reached a strength of specification.
c. The surveyor must check the following stub dimensions :
    i. Back to back (face and diagonal). Tolerance +/- 10-mm
    ii. Relative levels of top of stubs. Tolerance +/- 5-mm
d. The tower earthing must be installed according the drawings. Make sure that tower earthing has been installed before erection and has to be measured after erection finished.
e. Assembly of steelwork on the ground should be carried out in dedicated areas to avoid people working overhead.
f. Good housekeeping (i.e. keeping the site tidy) should be maintained during the tower erection operation.
g. Ensure movement pathways for men and machine are clear of obstructions and any hazards.

E. Erection Process: The following sequence of operation is to be adopted in the erection of Lattice Towers.

1. Base Leg Extensions – This step is best done with a Hydra Material Handler.

1.1 The first lift is the main leg which fits immediately above the stub. After lifting into position and bolting up the splice plates and bosom angles, a holding out rope is fixed to the top of the main leg to maintain the correct slope.
1.2 After installing the first leg and securing it, move to the next leg and repeat the operation described in E.1.1.1, securing each leg as the process goes.
1.3 Then horizontal belts brace and cross bracing bars, that fit between these legs are then lifted into position and secured.
1.4 The process then moves on to the remaining legs, in turn and operations described in E.1.1.1 thru E.1.1.3 are repeated until all 4 leg extensions are in place with all the horizontal and bracing members.

2. Body Extensions

2.1 A Gin pole is then lifted to the first horizontal at one of the main legs. The winch bond passes through a snatch block at the bottom of the main leg used by the gin pole and through a second snatch block at the top of the gin pole.
2.2 The same procedure as described in E.1.1.1 to E.1.1.4 is followed to compiete the body extension.
2.3 Providing the gin pole is 10m long it may be possible to lift the two adjacent main legs into position by leaning the gin pole towards each leg by adjusting the gin pole head guys. Head and foot holding out ropes are attached to each main leg to manuver them into position. ln this way the gin pole will only be moved to one other leg. However, the gin pole must not normally lean more than 15" to the vertical.

3. Common Portion

3.1.1 The gin pole is lifted, as required, to each new level of the tower.
3.1.2 All material can be lifted into position by the gin pole fixed at one leg. The gin pole is leaned over, as required, by adjusting the gin pole head guys.

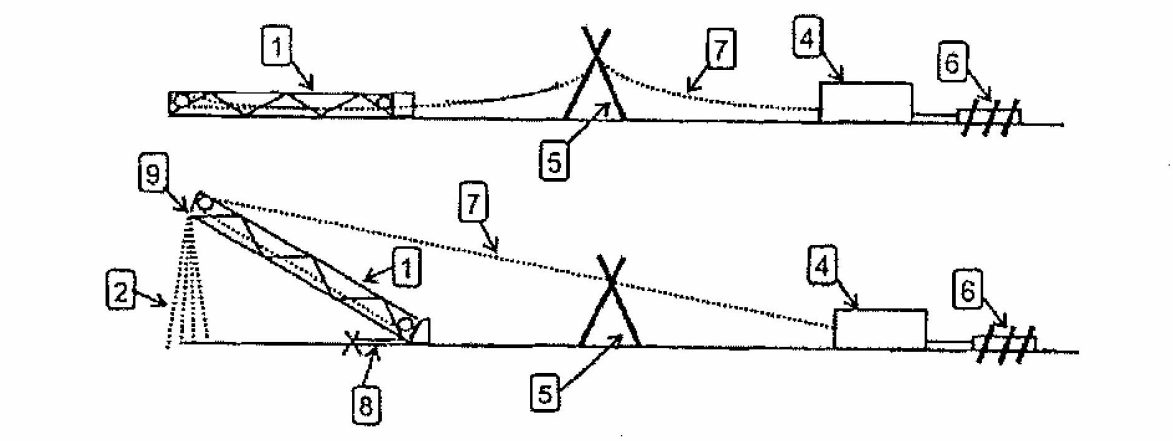
F. **GIN Pole Erection:** The procedure for lifting the steel work into position is the same as for described in section E. However, since the tower material is heavier and the base size of angle towers is wider, a 10m to 14m aluminium gin pole is used. The 'floating gin pole' methods is used with guys connected to the main legs of the towers.

The following safety considerations should be considered at all times when using a Gin Pole

- The gin pole should be lifted into the wind.
- The gin pole should not be used at an angle > 30˚to the vertical.
- Lifting hooks shall be completed with safety catch.

The following operations describe the additional information required ti lift lhe gin pole into position and subsequently raise the gin pole to new levels of the tower.

1. Raising Gin pole To The Vertical Position
   - 1.1 This is a straight forward operation, which requires good co-ordination to avoid accidents. It is important that the Erection Supervisor attends every lifting operation.
   - 1.2 The gin pole is laid out and assembled with its foot on a base plate at the centre of the tower. Slings are used to anchor lhe base plate to the existing stubs.
   - 1.3 The winch is positioned by the supervisor to suite the site conditions. lt is important that the winch operator has good visibility to all lifting operations.
   - 1.4 While the gin pole is lying on the ground, four guy ropes are pulled out from the head of the gin pole. They are positioned at 90˚to each other and anchored at a distance equal to the height of the gin pole.
   - 1.5 A falling gin pole is then positioned over the base plate. This is typically an a frame made up from two main legs. lt is common practice to connect a sling from the a frame to the gin pole to control its fall once the gin pole rises above the top of a frame.
   - 1.6 The winch bond is passed through the head of the a frame and head to the gin pole and caught off at the base plate.
   - 1.7 The gin pole is now ready for lifting. Before this operation begins the senior supervisor will check:
     - All the guys are correctly positioned with men at each anchor position.
     - The bonds and guys are not obstructed.
   - 1.8 The gin pole is slowly raised by the winch. The side guys should be monitored to ensure that the gin pole rises in line with the winch.
   - 1.9 When the derdck is above 45˚the rear guy should be very closely monitored. lt need to be applied quickly if there is a danger of the gin pole falling over towards the winch but otherwise should have some slack to that it does not work against the winch.



1.10 After the gin pole has reached the vertical position all four guys are caught off and the gin pole is ready to begin lifting operation.

2. Rising Gin pole To Higher Level

2.1 When the gin pole is lifted off the base plate it becomes a “floating” gin poles. It is supported from pennants connected to all four tower legs. The head guys pass through the blocks at the top of the main legs and continue to the stubs where they can be adjusted by tirfors.

2.2 Position on the main legs is chosen to fix the pennants. This is chosen to ensure :

- One - third of the gin pole remains inside the erected tower.
- The pennants hang at an angle of < 30˚to the gin pole.

2.3 The gin pole is lifted using a "Lazy" bond connected from the winch through a block at the top of one main leg and on to the bottom of the gin pole.

2.4 The head guys are released as the gin pole is lifted. When the gin pole has been raised to the correct height the pennants are connected and the head guys caught off.

The gin pole is then ready to re-start lifting operation.

G. TOWER CHECKING

a. After completion of the tower erection all bolts must be checked tightness, This operation should follow a logical sequence from bottom to top of the tower to ensure all bolts are checked.
b. The supervisor should complete and sign the Post Erection Inspection Form.

H. SAFETY: All workers have a responsibility towards Work Safety according to the Company Guidelines. Inparticular they must:

i. Wear the safety equipment provided.
ii. Check that the lower earthing is connected.
iii. Check their equipment daily and request the replacement of faulty items.
iv. Climb down from the tower during rain.
v. Never erect the tower if the foundation is not backfilled.
vi. Not work at night unless special provisions have been made.
vii. All Lifting Hooks must have an approved safety catch.
viii. All type of steel wire rope and nylon rope must be tension tested before use.
ix. At every 3 towers erection, gin pole must be checked against crack and rope lightening.
x. Anchorage must use anchor drill or other strong tools.
xi. If you are not sure about the anchor drill (example : rock area), please install the- spare anchor drill (2 pieces) at back.
xii. Maximum lifting capacity for 30m gin pole is 1.000 Kg.

The Foreman is responsible for implementing this erection safety procedure. In addition, a person should be appointed "banksman" to observe and direct the lifting operations involving the winches.

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TOWER ERECTION FLOW