Equipment & Formwork guidelines for Civil Construction

(this policy replaces the 'Methodology for Civil Constructions' policy)

With the view to improve timeframe and quality of construction, we are seeking to standardize the formwork used at our developments.

Footprint (sq. ft.)	Height of Building (above ground)	Suggested Shuttering System	Suggested Key Equipment for Civil Construction
<=25000	<= 30 m	Conventional / Pre-fabricated RC only for non-repetitive buildings eg. KCA; for all buildings with > 9 repetitions (of shuttering), Aluminium / assemblable shuttering / Pre-fabricated RC, if technically feasible.	
	< = 70 m	Aluminium / assemblable shuttering / Pre-fabricated RC, if technically feasible; external plaster not permissible.	External crane & VT for 45 m and higher;
	<= 150 m	Aluminium / assemblable shuttering; external plaster not permissible	Tower Crane; Man material hoist
	> 150 m	Jump form for core + linked formwork system; external plaster not permissible	Tower Crane; Man material hoist, boom placer
> 25000	<= 30 m	Table Formwork; external plaster to be avoided as far as possible.	Tower Crane; Man material hoist
	< = 70 m	Table Formwork; external plaster to be avoided as far as possible.	Tower Crane; Man material hoist
	<= 150 m	Jump form for core + Table Formwork/linked formwork system; external plaster not permissible	Tower Crane; Man material hoist, boom placer
	> 150 m	Jump form for core + Table Formwork/linked formwork system; external plaster not permissible	Tower Crane; Man material hoist, boom placer,

At +/- 10 m of the above heights, formwork & key equipment choice decision to be made in consultation with Construction Management based on category above or below.

In general, a contractor is expected to provide all plant and equipment required for the safe and timely execution of the works in its scope, unless it is specifically provided in the Contract that the same shall be provided by Lodha.

Hoists:

	45-70 m	**70-100 m**	**100-180 m**	**180-270 m**	**270 -360 m+**	**360 m+**
Man Material Hoist*		One cage per 6000 sft of floorplate BUA (or part thereof).; 0.5 m/s	One cage per 6000 sft of floorplate BUA(or part thereof).; 1 m/s	One cage per 6000 sft of floorplate BUA(or part thereof).; 1.5-1.6 m/s	One cage per 5000 sft of floorplate BUA(or part thereof).; 1.5-1.6 m/s	One cage per 4000 sft of floorplate BUA(or part thereof).; 1.5-1.6 m/s

- Min depth of 2.7 m and min. height of 2.1 m. Rectangular shape; min. 2 tonne and max. 2.5 tonne capacity per cage. If more than one cage is required, first use a double cage hoist (will count as two cages) and then move to a separate single or double hoist.
- Mast should not be triangular and preferably, square / rectangular.
- All hoists should be button operated (not with manual levers etc.)
- Motor should have IP 55 rating (minimum).
- The hoists should be located such that they are as close to the building face as possible (so that on any landing the travel distance is minimized). Hoists need to travel to the level at which material can be easily loaded (generally ground) and hence, cutouts need to be left in the podium, if so required, to ensure that the hoists can reach this level.
- In case of projects where there is little/no finishing required (eg. Office spaces), the requirement shall be 1/3rd of above viz. one cage every 18,000/12,000 sq. ft. (or part thereof).
- FML/Largely FML contract: If only one hoist is required on a building, it should be provided & operated by Lodha and fix monthly rate should be charged to the civil contractor (assuming 50% usage by the said contractor with monthly rent being 1.5% of the capital cost of the equipment) and free for all other contractors. If more than one hoist is required on a building (50% rounded down to nearest integer) should be provided & operated by the Civil Contractor and balance by Lodha (no charge to Civil Contractor). Civil Contractor should keep its hoists and operate them for use of other contractors on site for upto 6 months after completion of all civil works – monthly rate for this should be quoted in the civil contract (should not exceed 1.5% of the capital cost of the equipment). Allocation of usage timings of Lodha provided hoists shall be done by Lodha CM.
- FLO/Largely FLO contract: All hoists shall be provided and operated by Lodha. Rent for 50% of the hoists provided (calculated @ 1.5% per month of the capital value x 50%) shall be charged/debited to the Civil Contract and for all other contractors it shall be free.

- Hoist should be installed & operation at the site by the time the 7th level above ground is completed for the said building. About 2-3 weeks should be estimated for installation and operationalization (commissioning) after full arrival of material at site.
- In case of buildings with height > 180 m, it is possible to install some of hoists in a manner that they serve only some part of the floors and hence, their run length can be moderated and capex can be saved. Procurement should discuss this with site CM head prior to ordering the hoists.
- As far as possible, man material hoist should be placed only along a RC wall not requiring external plaster to avoid delay during external plaster stage + platform to take goods from man material hoist to floor should be as per Lodha EHS specifications
- Usage of temporary elevators (installed prior to completion of the core) inside the building shaft is NOT to be considered, unless it is the final elevator. If it is really needed, same may be done in the service lift shaft only, provided such service lift does not open in the floor lift lobby.
- Hoists at Lodha sites should only from approved brands (including those that are bought by contractors). List of approved brands is stated in **Annexure B**. Any new brands can be added only with written approval of COO + HOD-Procurement (Civil) + HOC-P&E
- For location of installation, see 'Site setup and Logistics Learnings' policy.
- While considering renting, installation/uninstallation costs should be understood and paid separately from regular monthly rental – this will ensure that even if period of use is extended, we only pay the usage component and not the installation/uninstallation related component.

Cranes

- Crane's jib should be of sufficient length and the crane should be located in such a manner that the entire (100%) footprint of the building and material laydown area is covered. To achieve this, multiple cranes may also be required. To decide the no. of cranes, hook analysis (covering all items which require crane for lifting, not just civil items) for the same needs to be conducted by the P&E cell (Procurement to take this info from the P&E cell prior to float of tender). Generally, on all fast track jobs atleast 2 cranes are needed so that breakdown of one (the only) crane doesn't bring the job to a halt.
- To determine the lifting capacity of the crane, the largest load that is required to be carried by the crane should be taken into consideration and specified prior to procurement of the crane by P&E cell (Procurement to take this info from the P&E cell). Generally, the lift machine or pre-cast stairs or structural steel members are the largest load that a crane would carry.
- Luffing cranes should be considered when any one (or more) of the following 4 situations is likely to be applicable a given building:
    - The hammerhead crane is located in a manner which will force its tip to go into someone else's site when covering its full range of movement as required to service the building ("oversailing").
    - The building height is > 200 m above ground.
    - Two or more cranes are installed and they are likely to intersect each other's path **frequently.** In such case atleast one of them (if not both) should be a luffing crane.
    - If the building is being constructed using a jump form system.

It is clarified that not all cranes need to be luffing on a job which qualifies as per the norms above. Combination of luffing and hammerhead can also be suggested.

- If a crane can intercept any other crane or structure in its full range of movement, anti-collision system is required.
- Jib length may vary from 30 – 60 m, with norm being 50 m.
- External cranes may be considered only for buildings upto 70 m height, else internal cranes should be used. Procurement should discuss this with site CM head prior to ordering the crane.
- FML/Largely FML contract: Crane should generally be in the scope of the civil contractor. Civil Contractor should keep its crane on site & operate it for use of other contractors for upto 6 months after completion of all civil works – monthly rate for this should be quoted in the civil contract (should not exceed 1.5% of the capital cost of the equipment).
  FLO/Largely FLO Contract: Lodha should buy the crane and same should be rented/debited to the civil contractor @ 1.25% of the capital value per month. Contractor is responsible for operation and maintenance of the crane during his period of use on the building + 6 months thereafter (no rent shall be chargeable during this 6 month period) and for returning it in good working condition, only subject to normal wear and tear. Contractor shall be responsible for erection and dismantling of the crane. Contractor is also responsible for all repair / maintenance of the crane(s) during this period and is required to take a comprehensive maintenance contract during this period. If there is any excessive wear and tear / damage on the crane, appropriate value shall be debited to the contractor, as determined by the P&E cell (appropriate terms to be incorporated in the scope of the contractor).
- Cranes at Lodha sites should only from approved brands (including those that are bought by contractors). List of approved brands is stated in **Annexure A**. Any new brands can be added only with written approval of COO + HOD-Procurement (Civil) + HOC-P&E
- For location of installation, see 'Site setup and Logistics Learnings' policy.
- While considering renting, installation/uninstallation costs should be understood and paid separately from regular monthly rental – this will ensure that even if period of use is extended, we only pay the usage component and not the installation/uninstallation related component.

Boom Placer

- For buildings > 100 m height above ground,
  - Civil contractor should provide boom placer if the core is going to be go up higher than the rest of the floor plate (jump form or slip form for the core).
  - Also, Civil contractor should provide boom placer if the floorplate BUA is > 10,000 sq. ft.

Concrete Pump

- To be provided by Civil Contractor, including pipelines.
- Atleast one pump is required per 10,000 sq. ft. floorplate BUA (or part thereof).
- Any additional concrete pumps required for concreting activities shall have to be provided by the Civil contractor (/debited to him).

Loading Platform

- To be provided by the same party which is providing the crane.
- Loading platforms should be provided as 4 sets per 10,000 sq. ft. floorplate BUA (or part thereof).

Other key equipments to be provided by Contractors

- **Civil Contractor:** Curing pump, vibrator, dewatering pump (not to be provided by FLO/PMFL (which is essentially FLO) contractors).
- **Contractors responsible for fixing of wall partitions:** Trolleys or wheel barrows, as suitable for shifting of wall partition material within the floor.

All equipment should also adhere to the guidelines stated in 'Logistics Learnings'. Contractors are responsible for ensuring that all equipment are operational with uptime of > 95% during working hours, failing which Site CM may debit them for underperformance of the equipment as per prevailing rental rates for equivalent equipment.

Logistics & equipment plan for any project should be approved by COO/P&E cell (in writing) prior to award of Civil Contract. Procurement team should ensure that Civil Contract is not awarded prior to this being finalized. In case of FML Civil Contractors, they should submit their Logistics & equipment plan prior to finalization of the tender and the same should be approved by COO / HOC-P&E.

Any exceptions to the aforesaid equipment norms may be done with concurrence of COO + HOD-Procurement with reasons to be recorded in writing.

Notes:

1. For any of the above options, conventional shuttering may be considered in case that conventional shuttering options gives atleast a 10% faster overall timeframe for the projects (not necessarily at building level), as compared to the aforesaid options.
2. Wherever conventional shuttering is used, all civil contractors to have:
    a. 50% of the column shuttering for one level of the building (applicable for conventional shuttering projects).
    b. 1 levels worth of slab shuttering.
    c. 1.5 levels of slab propping
    d. 2 levels worth of beam bottoms and props
    e. No wooden props (bamboos) to be allowed for any building
    f. Only channels (no spans) to be allowed for any building above 30 m
    g. H-frame scaffolding to be insisted as part of Civil Contract wherever there is external plaster
3. Contracts to ensure that scope of work of Civil Contractors is clearly defined wrt activities to be handled by them (avoiding need for petty works to be given to small contractors).
    a. Following activities/materials/equipment should be included in scope of work of all civil contractors:
        i. Curing pumps, bar cutting and bending machines, grinders

ii. Civil works for landscape , security cabin and compound wall and gate columns , IPS / concrete floors

b. Following additional activities/materials/equipment should be included in scope of Grade A contractors, where work is given on with material basis:
   i. As above + Waterproofing , structural fabrication work
   ii. As above + all equipment required for construction as per policy above + welding machine

4. As far as possible, design to ensure that all beams on a typical floor to have the same depth.
5. As far as possible, design to ensure beams above doorframe to be either upto lintel height or if not, atleast 400 m above lintel.
6. For easy repetition of assemblable shuttering, ensure there is no variation in floor to floor height of those buildings where the shuttering is intended to be reused.
7. For large footprint, post-tensioned (PT) reinforcement should be considered to reduce structural costs.
8. For project where table forms are used, periphery beams are to be avoided in design. In such cases, internal beams are only permissible perpendicular to the periphery.

Annexure A

List of Approved Crane Manufacturers

Hammer Head	**Notes**
Potain	Max. Tonnage <= 12 ton and tip load < 3 ton (@ 50 mtrs jib)
Liebherr	
Terex	
Zoomlion	
SYM (Shenyang Sanyo Building Machinery)	
SCM (Sichuan Construction Machinery Group)	
ACE	Max. Tonnage <= 6 ton and tip load < 1.3 ton (@ 50 mtrs jib). Cannot be used for height > 150 m.
Luffing	**Notes**
Potain	Max. Tonnage <= 16 ton and tip load < 4 ton (@ 50 mtrs jib)
Liebherr	
Terex	
Wolf	
SYM (Shenyang Sanyo Building Machinery)	Max. Tonnage <= 12 ton and tip load < 13 ton (@ 50 mtrs jib). Cannot be used for height > 250 m.
Zoomlion	

For any non-European/American crane, pre-dispatch inspection has to be conducted by the representative of the purchaser (Lodha or Contractor) and the entire crane has to be assembled during this pre-dispatch inspection to ensure that the appropriate parts are put in the package being shipped. For Lodha, this responsibility shall be carried out by the P&E cell.

Purchase of second hand cranes is permissible if the same is pre-certified by the manufacturer whose names appear in Annexure A and the said manufacturer is not of Chinese origin (can have plant in China).

Annexure B

List of Approved Hoist Manufacturers

Hammer Head	Notes
Alimak	
GEDA	
Lifteck	
GOAIN	
SYM (Shenyang Sanyo Building Machinery)	
SCM (Sichuan Construction Machinery Group)	
GJJ (Changsha Jing Long Engineering Machinery Co)	Cannot be used for height > 200 m.
Shanghai Baoda Engineering Machinery Co. Ltd. (BAODO)	
CMAX	Cannot be used for height > 150 m.
Europa	

For any non-European/American crane, pre-dispatch inspection has to be conducted by the representative of the purchaser (Lodha or Contractor) and the entire crane has to be assembled during this pre-dispatch inspection to ensure that the appropriate parts are put in the package being shipped. For Lodha, this responsibility shall be carried out by the P&E cell.

Purchase of second hand cranes is permissible if the same is pre-certified by the manufacturer whose names appear in Annexure A and the said manufacturer is not of Chinese origin (can have plant in China).