

CONSTRUCTION SKILLS TRAINING INSTITUTE

SKILL STANDARDS

FORM WORK CARPENTRY



**CONSTRUCTION GROUP
LARSEN & TOUBRO LIMITED**

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COMMITTEE

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FOREWORD

Larsen & Toubro Limited (L&T) wish to regulate and promote Construction Vocational Training in India. To this end, L&T have established a Memorandum of Understanding with Henry Boot Training Limited and the Construction Industry Training Board of U.K. This is to assist in the development of a Unified Modular Training System for Construction related trades, which will supply the Industry with significant numbers of workers, trained to limited but recognised skill levels, in the shortest possible time. The system will be tried and tested by L&T and thereafter be offered to the Construction Industry Development Council of India as a model approach. The framework of the system will be designed to enable both new entrants to the Industry and skilled workers in the Industry to progressively improve their levels of skills and knowledge competency in their respective occupation and award them a skill certificate level, which is nationally recognised.

As a pre-requisite to the above, it is necessary to establish the Occupational Skill Standards, which the Industry requires from its employees. An Occupational Skill Standard is defined as written specification setting out the requirements of knowledge and skills in respect of a particular occupation or trade. To develop Construction skill standards, different committees were constituted, consisting of Senior executives of L&T ECC Group. They worked in collaboration with Messrs. Henry Boot Training Limited, U.K. and Construction Industry Training Board, U.K.

The committee has brought out this book, which defines the skill standards and gradation in the skill level. Stratification of skills into three different levels (starting from level III and progressing to level I) has been done. There is a clear definition of Knowledge & Skills at each level. This is to encourage a progressive career growth for the individual and also a climate for continuous improvement of Knowledge & Skills in the Industry.

These Standards are used as a basis in the development of training programmes and in the implementation of Trade Testing and Certification. Employers in the construction Industry can confirm that employees, who achieve these Skill Standards, will meet the needs of the Industry and this will result in :

1. Improved productivity of each person
2. Increased job satisfaction
3. An opportunity for progressive career growth for the individual
4. Reduced labour turnover
5. Improved industrial relations
6. Improved safety practice leading to fewer accidents
7. Improved workmanship resulting in timely and effective completion of the project
8. Improved performance of the firms

Skill standards are a dynamic means of improving the quality in Industry. Such standards may be modified and improved as necessary to meet the changing needs of the Industry. I am sure this will usher in a sea of change in the Industry and fulfil a long felt need for recognition of Construction trades, as an organized industrial sector in the nation building process.

Larsen & Toubro Limited wishes to acknowledge the support given by

Mr. David Hammond, Director

M/s. Henry Boot Training Limited, U.K.

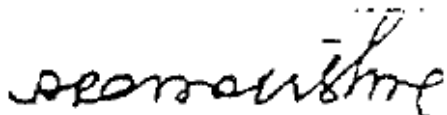
and

Mr. Terry Kivlin, Training Manager

M/s. Construction Industry Training Board, U.K.

for co-ordinating the efforts of the committee in drawing up these Construction Skill Standards.

I, on behalf of Larsen & Toubro Limited, wish to place on record my thanks to the committee, for their untiring efforts, in bringing about these excellent Skill Standards in the shortest time available at their disposal.



A. RAMAKRISHNA

MEMBER OF THE BOARD AND PRESIDENT (OPERATIONS)

LARSEN & TOUBRO LIMITED

Chennai

Feb. 1999

FORMWORK CARPENTER

GENERAL DESCRIPTION:

A Formwork Carpenter makes, assembles, erects and dismantles conventional/system formwork for all types of RCC construction including pre-cast, taking into consideration safety, dimensional accuracy and quality standards as per relevant codes of practices and methods.

SPECIFIC DESCRIPTION

1. Examines, reads, understands formwork drawings and specifications pertaining to formwork.
2. Makes simple formwork schemes/sketches.
3. Calculates simple areas, quantities and dimensions.
4. Marks out as per drawings in metric and FPS system
5. Uses plumb bob, spirit level, water level, line-dhori, steel rule, squares, dividers, wing compasses, center punches, jack plane, try square, rule, marking gauge, marking knife, mortice gauge, tenon and dovetail saw.
6. Has basic knowledge of timber, plywood and standard steel components.
7. Knows the acceptance criteria of timber, plywood and steel components as per the relevant codes (IS 4990:1993, IS800 1987) and specifications.

8. Identifies the system components by its name.
9. Identifies, uses and maintains various hand tools and power tools related to formwork taking into consideration all safety precautions.
10. Has knowledge of consumables for making formwork and finishing.
11. Has knowledge of first aid procedures while using consumables
12. Has knowledge of safety appliances including safety belt, helmet, and safety net for working at heights.
13. Has knowledge of safety practices while facing fire hazards, while working near temporary electrical installations.
14. Works responsibly and safely without endangering self or others.
15. Has knowledge of various form finishes and its correct application.
16. Identifies/selects and prepares rough timbers to finished sizes.
17. Marks and makes half lap joints, mortice and tenon tee joints, dovetail joints including oblique joints.
18. Makes, assembles and dismantles conventional shutter panels for foundation, column, beam, slab, wall, lintel, chajja, arch and curved shutters for curved structural members.
19. Makes, assembles and dismantles system formwork for foundation, column, beam, slab, wall, lintels, chajja, arches and curved shutters for curved structural members.

20. Makes, assembles and dismantles special shutters including staircase shutters, haunch shutters.
21. Makes, assembles and dismantles pre-cast moulds.
22. Builds and erects temporary staging for conventional formwork.
23. Builds and erects scaffolds for temporary access.
24. Builds and erects walkway platforms including handrails, footboards, etc.
25. Has knowledge of various shutter lifting and handling methods (both manual and mechanical methods) and relevant tools and tackles.
26. Has knowledge of sequence of shuttering and de-shuttering.
27. Inspects the line, level, alignment and dimensions of the formwork
28. Inspects the stability of the staging, props, walkways and scaffolds.
29. Carries out miscellaneous works including chutes, pockets, hoardings
30. Checks the position of the formwork during the placement of concrete.
31. Has formwork-related knowledge of reinforcement, concrete and curing.
32. Has knowledge of re-propping and back-propping techniques.

33. Assembles operates and dismantles special system forms including tunnelform, slipform and all types of climbing formwork.
34. Stores and maintains formwork components.
35. Carries out proper house keeping.
36. Makes doors and windows for temporary structures.
37. Repairs all type of formwork.
38. Ensures proper/optimum utilization of the formwork materials.

SKILL STANDARD – FORMWORK CARPENTER

LEVEL III

KNOWLEDGE:

A. Level III Form work Carpenter must

1. Identify hand tools including

1.1. Measuring tools

1.1.1. Wooden rule

1.1.2. Steel tape

1.1.3. Zig-zag rule

1.1.4. Divider

1.1.5. Calipers

1.2. Marking and testing tools

1.2.1. Trammel

1.2.2. Marking knife

1.2.3. Spirit level

1.2.4. Plumb bob

1.2.5. Straight edge

1.2.6. Winding strip

1.2.7. Gauges

- 1.3. Cutting tools
 - 1.3.1. Saws
 - 1.3.2. Chisels
 - 1.3.3. Gouges
- 1.4. Planing tools
 - 1.4.1. Bench planes
 - 1.4.2. Curve cutting planes
 - 1.4.3. Special purpose planes
- 1.5. Striking tools
 - 1.5.1. Hammers
 - 1.5.2. Mallets
- 1.6. Boring tools
 - 1.6.1. Country drills
 - 1.6.2. Hand drills
 - 1.6.3. Breast drills
 - 1.6.4. Automatic drills
 - 1.6.5. Brace
 - 1.6.6. Gimlet
 - 1.6.7. Bradawl
 - 1.6.8. Augur
 - 1.6.9. Bits

- 1.7. Driving tools
 - 1.7.1. Screw drivers
 - 1.7.2. Spanners
 - 1.7.3. Punches
- 1.8. Holding and supporting tools
 - 1.8.1. Bench hook
 - 1.8.2. Miter box
 - 1.8.3. Tool box
 - 1.8.4. Sawing trestle
 - 1.8.5. Work bench
 - 1.8.6. Carpentry clamps
 - 1.8.7. Vices
- 1.9. Abrading tools.
 - 1.9.1. Abrasive papers
 - 1.9.2. Files
 - 1.9.3. Sharpening stones
- 1.10 Miscellaneous tools
 - 1.10.1 Pincers

- 1.10.2 Carving chisels
 - 1.10.3 Brushes
 - 1.10.4 Saw set
 - 1.10.5 Bazullah
2. Identify (but not to use) power tools including
 - 2.1 Circular saw
 - 2.2 Band saw
 - 2.3 Planing machine
 - 2.4 Surfacer
 - 2.5 Thicknesser
 - 2.6 Orbital saw
 3. Identify grinder.
 4. Have knowledge of consumables including wire nails, screws, bolts panel pins, timber plugs, and release agents.
 5. Have knowledge of first aid procedures for using above consumables.
 6. Have knowledge of safety appliances like safety belt, helmet, safety net for working at heights.

7. Have knowledge of safety practices towards fire hazards and temporary electrical installations.
8. Make simple calculations concerned with carpentry such as addition, subtraction, multiplication and division.
9. Read simple form work sketches.
10. Have the knowledge of proper house keeping

SKILLS:

A. Level III Formwork Carpenter must be able to

1. Use and maintain basic hand tools mentioned above.
2. Use grinder.
3. Build and erect temporary staging for conventional formwork.
4. Build and erect scaffolds for temporary access.
5. Build and erect walkway platforms including handrails, footboards, etc.
6. Use screws, nails, dowels glue, foam sheet.
7. Work responsibly and safely without endangering self or others.
8. Store and maintain formwork components.
9. Carry out proper house keeping.

10. Carry out the following carpentry operations manually to tolerances of $\pm 2\text{mm}$ planing, cutting, chiseling rebating and grooving.
11. Assist in setting out by fixing pegs.
12. Handling shutter panels in position during assembly and dismantling .

SKILL STANDARD – FORM WORK CARPENTER
LEVEL II

KNOWLEDGE:

In addition to knowledge and skill items outlined for Level III Formwork Carpenter a Level II form Work Carpenter must:

1. Read and prepare simple drawings and sketches of formwork.
2. Calculate areas for simple geometrical figures like square, rectangle, triangle and circle with quantities and dimensions.
3. Understand the procedures and methods of setting out levels, plumb, squareness and angles with reference to datum.
4. Have basic knowledge of timber, plywood and standard steel components.
5. Understand the physical properties of wood, seasoning of timber, storage of timber to prevent decay, distortion, bending, splitting and timber treatments.
6. Understand the proper selection and applications of timber joints.
7. Identify the system formwork components by its name.
8. Have knowledge of various safety precautions and measures.
9. Identify and understand the uses of power tools such as
 - 9.1 Circular saw

- 9.2 Band saw
 - 9.3 Planing machine
 - 9.4 Surfacers
 - 9.5 Thicknesser
 - 9.6 Orbital saw
 - 9.7 Sander
- 10. Know how to sharpen chisels and plane blades.
 - 11. Know how to sharpen and set saws using precision saw sets.
 - 12. Have knowledge of consumables in carpentry work including adhesives, varnishes, polishes, paints, sandpaper, emery paper, wood primers, paint solvents.
 - 13. Have knowledge of various shutter lifting and handling (both manual and mechanical) methods and relevant tools and tackles.
 - 14. Have formwork-related knowledge of reinforcement, concrete and curing.

SKILLS:

- 1. Identify / select and prepare rough timbers to finished sizes.
- 2. Set out layout of formwork including transferring lines and levels.
- 3. Mark and make half lap joints, mortice and tenon tee joints, dovetail joints including oblique joints.

4. Make, assemble, erect and dismantle conventional shutter panels including foundation, column, beam, slab, wall, lintels chajja, arches and curved shutters.
5. Assemble, erect and dismantle system formwork for foundation, column, beam, slab, wall, lintels, chajja, arches and curved shutters for curved structural members.
6. Make, assemble, erect and dismantle special shutters including staircase shutters and haunch shutters.
7. Make and assemble pre-cast moulds.
8. Use hacksaws and various types of files such as triangular, round and flat file.
9. Operate safely and maintain small machines including drilling machines screw fixing machine, sander, orbital saw.
10. Operate safely and maintain machines including circular saw, chain saw, surface planer, thickener.
11. Carry out miscellaneous works including chutes, pockets, hoardings.
12. Make doors and windows for temporary structures.
13. Set out according to drawings in metric and FPS system.
14. Use plumb bob, spirit level, water level, line-dhori, steel rule, squares, dividers, wing compasses and center punches.
15. Inspect formwork for stability, dislocation, deformation and grout tightness during placing of concrete.

SKILL STANDARD – FORMWORK CARPENTER

LEVEL I

KNOWLEDGE:

In addition to knowledge and skill items outlined for level III and level II, a Level I Formwork Carpenter must.

1. Examine, read, and understand formwork drawings and specifications pertaining to formwork.
2. Make simple formwork schemes / sketches.
3. Know the acceptance criteria of timber, plywood and steel components as per the relevant codes (IS4990: 1993, IS800: 1987) and specifications.
4. Know various form finishes and its correct application.
5. Do sequence of shuttering and de-shuttering.
6. Do re-propping and back-propping as per standard techniques.
7. Estimate and cost formwork.
8. Ascertain the spacing of the load bearing formwork members from the load charts available from the manufacturers of system formwork.

SKILLS:

1. Assemble operate and dismantle special system forms including tunnelform, slipform and all types of climbing formwork.
2. Guide a team of Level II and level III carpenters.
3. Estimate time schedule and the worker requirement for making, assembly and dismantling of formwork.
4. Inspect the line, level, alignment and dimensions of the formwork.
5. Inspect the stability of the staging, props, walkways and scaffolds.
6. Ensure proper / optimum utilization of the materials.
7. Ensure optimum deployment of manpower to maximize productivity.

ACKNOWLEDGEMENTS

The Committee wishes to acknowledge the total support given by the following executives of L&T:

Mr. A. Ramakrishna	Member of the Board and President (Operations) L&T and Vice-Chairman-CIDC
Mr. K.V. Rangaswami	Vice President - Buildings & Infrastructure Projects
Mr. S. Chandrasekar	General Manager - Plant & HRD
Mr. V.B. Gadgil	Jt. Genl. Manager (Buildings & Factories)
Mr. K.P. Raghavan	Jt. Genl. Manager (Buildings & System Housing)
Mr. S.R. Kumar	Jt. Genl. Manager (Development - Buildings & Infrastructure)
Mr. M. Kalyanasundaram	Sr. Manager (Buildings & Factories)
Mr. M.G. Vasudevan	Manager (Buildings & Factories)

The publications of the following organisations have been used for reference :

- Henry Boot Training Limited, U.K. (Training Standards)
- Construction Industry Training Board, U.K. (Training Manuals & Training Specifications)
- The Directorate General of Employment and Training of Ministry of Labour & Employment, Govt. of India
- Bureau of Indian Standards
- CIDC
- NICMAR

The following in-house documents of L&T ECC Construction Group have been used for reference

- Construction Group Work Procedures
- Construction Quality Assurance Manuals
- Construction Project Quality Plan Manuals