

Ironworker

Occupational Analysis Report

April 2014



Commission
de la construction
du Québec

The purpose of this report is to describe as accurately as possible the trade of ironworker as currently practiced in Quebec's construction industry. It is a record of discussions held by a group of workers who met for the occasion after industry partners recommended them to the Commission de la construction du Québec (CCQ) for their expertise in the trade.

The occupational analysis is a first step in the definition of the competencies required for practicing the trade. This report becomes one of the reference and decision-making tools used by the CCQ for teaching and learning purposes.

This report does not bind the CCQ in any way. It has no legal effect and is meant as a reflection of discussions held on the date of the analysis workshop.

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The masculine gender is used generically
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TABLE OF CONTENTS

INTRODUCTION	1
1. GENERAL CHARACTERISTICS OF THE TRADE	3
1.1 DEFINITION OF THE TRADE.....	3
1.2 JOB TITLES	5
1.3 SECTORS OF ACTIVITY.....	5
1.4 FIELD OF PRACTICE	7
1.5 LAWS AND REGULATIONS.....	7
1.6 WORKING CONDITIONS	8
1.7 JOB MARKET ENTRY CONDITIONS.....	10
1.8 PLACE OF WOMEN IN THE TRADE	12
1.9 CAREER PROSPECTS	12
1.10 DEVELOPMENT OF THE TRADE.....	12
1.11 IMPACT OF ENVIRONMENTAL STANDARDS ON THE PRACTICE OF THE TRADE	13
2. WORK DESCRIPTION	15
2.1 TASKS AND OPERATIONS	15
2.2 OPERATIONS, SUB-OPERATIONS AND CLARIFICATIONS	20
2.3 ACHIEVEMENT CONDITIONS.....	41
2.4 PERFORMANCE CRITERIA.....	43
2.5 FUNCTIONS	47
3. QUANTITATIVE DATA ON TASKS	49
3.1 OCCURRENCE.....	49
3.2 WORK TIME.....	50
3.3 IMPORTANCE AND DIFFICULT OF TASKS.....	51
4. KNOWLEDGE, SKILLS AND ATTITUDES	53
4.1 KNOWLEDGE	53
4.2 SKILLS	55
4.3 ATTITUDES	57
5. TRAINING SUGGESTIONS	59
Annexes	61
Annex 1 Raw Materials, Tools and Equipment	63
Annex 2 Matrix of Occupational Health and Safety Hazards	71
Annex 3 Comments and Approval of the Ironworker Vocational Subcommittee.....	81

List of Tables

- 1.1 Allocation of Hours Worked per Sector of Activity 6**

- 2.1 Tasks and Operations 6**
- 2.2 Sub-Operations and Operation Clarifications..... 20**
- 2.3 Achievement Conditions..... 41**
- 2.4 Performance Criteria 43**

- 3.1 Task Occurrence..... 49**
- 3.2 Work Time Allocated to Each Task..... 50**
- 3.3 Importance and Difficulty of Tasks 52**

- A.1 Tools and Equipment 63**
- A.2 Occupational Health and Safety Hazards in the Ironworker Trade..... 71**

INTRODUCTION

In early 2009, the Direction de la formation professionnelle of the Commission de la construction du Québec (CCQ) launched a large-scale operation to review the occupational analyses¹ of all construction industry trades.

The CCQ undertook this operation for many reasons, particularly the following:

- the project to reform the construction workforce apprenticeship and management system, and the coming design of qualitative apprenticeship logbooks requiring a detailed description of each trade;
- the fact that most construction occupational analyses² had been conducted between 1987 and 1991 and had not been reviewed since;
- updates to vocational qualification examination question banks;
- implementation of Chapter 7 of the Agreement on Internal Trade (AIT) and of the Québec-France Understanding on the Mutual Recognition of Professional Qualifications.

These factors demonstrate the necessity of updating the occupational analyses in order to obtain a current and complete provincial profile of the various trades.

The occupational analysis of the ironworker trade belongs to this context³. Its purpose is to describe this trade as currently practiced by journeymen in the construction industry. This report was written in order to collate and organize the information gathered during the occupational analysis workshop held in Laval on December 10 and 11, 2013.

This analysis draws a portrait of the trade (tasks and operations) and its working conditions, and identifies the skills and behaviours required. The report of the occupational analysis workshop is an accurate reflection of the consensus reached by a group of ironworkers. A special effort was made to include in this report all the data collected during the workshop and to ensure that the data accurately depict the realities of the trade analysed.

1. The terms “profession” and “trade” are considered synonymous.

2. Called “work situation analyses” at the time.

3. This occupational analysis was conducted according to the *Cadre de référence et instrumentation pour l'analyse d'une profession*, produced in 2007 by the ministère de l'Éducation, du Loisir et du Sport (Direction générale de la formation professionnelle et technique) and the Commission des partenaires du marché du travail, ministère de l'Emploi et de la Solidarité sociale.

1. GENERAL CHARACTERISTICS OF THE TRADE

1.1 DEFINITION OF THE TRADE

According to the Regulation to amend the Regulation respecting the vocational training of workforce in the construction industry, Schedule A, section 9, the term “ironworker” means any person who, with the exception of work done for the construction or maintenance of electric power transmission and distribution lines, performs:

- [...] a) the erection and assembly of all iron and steel parts used in the construction of:
- i. buildings, including partitions, prefabricated roofs, wall sections including metal windows;
 - ii. completely prefabricated buildings;
 - iii. bridges, viaducts, subways and tunnels;
 - iv. antennas for radio and television broadcasting stations;
 - v. hoists, car dumpers, cranes, conveyors, ore unloaders;
 - vi. lock gates, head gates;
 - vii. hydraulic regulating equipment;
 - viii. coal, stone, coke, sand and ore towers, bins and hoppers;
 - ix. ash chutes and hoppers;
- b) the erection of concrete structural members (wall panels, floor or ceiling slabs) when mechanical equipment is used;
- c) the erection and construction of all sectional and otherwise assembled stacks, as well as the extension and repair of such stacks;
- d) the unloading, hoisting and setting of complete boilers, steam drums and assembled sections of tubular boilers and machinery into their approximate positions;
- e) torch-cutting, welding, riveting, rigging, scaffolding, framing, erecting and dismantling of temporary or supporting work in connection with any of the above operations;

- f) by means of equipment, tools or welding, the tracing, cutting, preparation and assembly of all metal pieces for the manufacture of items such as: inside and outside stairs, railings, fences (except wire fences), gates, windows, canopies, cellar and inspection traps, all types of wire netting, coal chutes, vault doors, fire doors, partitions, lifesaving equipment or any other similar work; and the installation and erection of the above items.

Performance of the work described in the first paragraph includes trade-related handling for the purposes of immediate and permanent installation.

Ironworkers perform all the work mentioned in that definition.

The participants agreed with this definition, which represents their tasks adequately. However, they mentioned that work on metal windows is quite rare and limited to frame assembly.

The participants added that the parts they assemble are not exclusively metallic.⁴

Ironworkers work on the erection and assembly of:

- **structural** elements (members) involved in the construction, for example, of:
 - buildings;
 - prefabricated buildings;
 - bridges and viaducts;
 - subways and tunnels;
 - antennas for radio and television broadcasting stations;
 - wind meters;
 - wind turbines;
 - embedded parts and door guides;
 - stacks;
 - beam lifters, hoists, car dumpers, cranes, gantry cranes, conveyors, ore unloaders;
 - lock gates, head gates;
 - hydraulic regulating equipment;
 - coal, stone, coke, sand and ore towers, bins and hoppers;
 - ash chutes and hoppers;
 - reinforcements of all types (overhead travelling structures, bridges, columns, beams, MegaDomes, aluminium structures, etc.);
 - conveyor ways;
 - expansion joints;
 - seismic dampers;
 - etc.

4. The CCQ's Direction de l'application des conventions collectives has expressed a reservation on the addition of new materials likely to be installed by ironworkers, in the event that a jurisdictional dispute committee is formed as provided by the collective agreements or that a judge of the Commission des relations de travail rules that the installation of those new materials must either be exclusive or shared between other trades or occupations.

- **architectural** elements involved in construction. For example:
 - inside and outside stairs;
 - railings;
 - fences (except wire fences);
 - balcony and door supports;
 - bathroom vanity supports;
 - stadium seat supports;
 - guardrails;
 - balconies;
 - coverings (e.g.: of counters, walls, etc.);
 - decorative panels;
 - hand rails, shields and lintels;
 - ladders;
 - suspensions and mezzanines;
 - louveres;
 - gates, windows and canopies;
 - cellar and inspection traps;
 - wire netting and coal chutes;
 - vault, fire and prison doors;
 - partitions;
 - lifesaving equipment;
 - guard posts and guide rails;
 - manhole covers;
 - railings and drains;
 - moorings (bollards);
 - etc.

1.2 JOB TITLES

On construction sites, although the recent job title⁵ “ironworker” is used, workers are still called, for example, “locksmiths,” “steelworkers,” “stairway workers,” “iron installers,” “ornamental iron installers,” “riggers,” etc.

Since it is the official name of the trade, the job title of the “ironworker” will be used in this report.

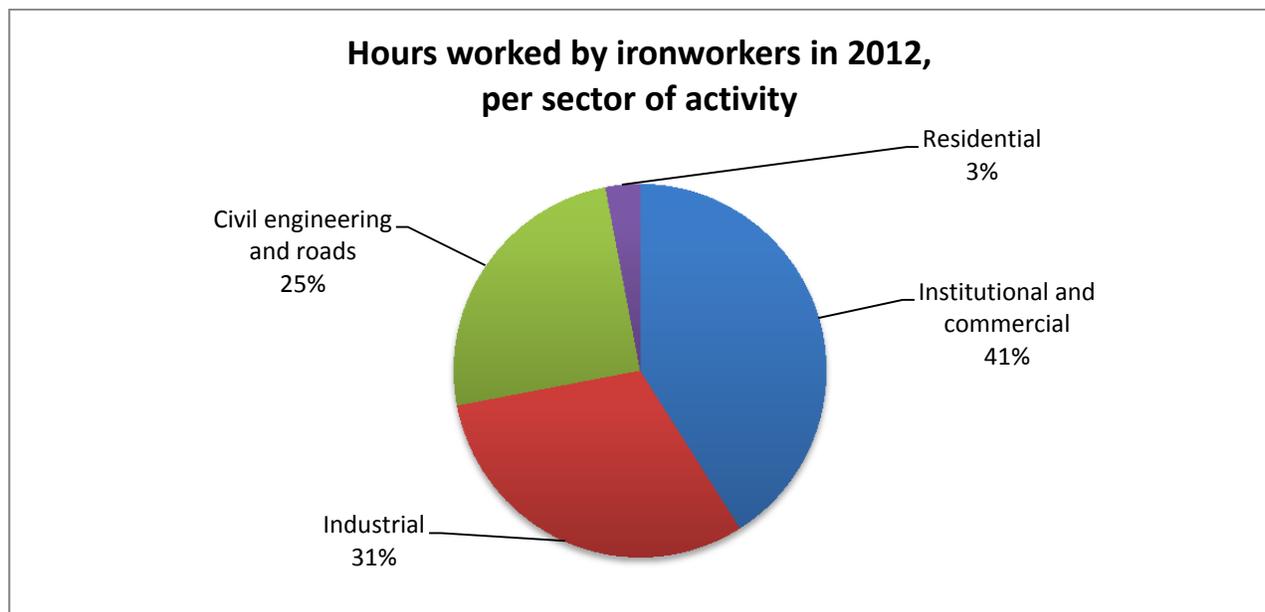
1.3 SECTORS OF ACTIVITY

Ironworkers are active, to varying degrees, in the four construction industry sectors:

- residential;
- institutional and commercial;
- industrial;
- civil engineering and roads.

5. The trades of ornamental ironworker and structural steel erector were merged on July 18, 2013, and the term used for designating workers performing those tasks is henceforth “ironworker.”

The chart below illustrates the allocation of hours worked by all ironworkers in Quebec in 2012⁶.



After the above graphic was presented, we asked the participants to list the sectors where they practice their trade. The results appear in Table 1.1 below.

Table 1.1 Allocation of Hours Worked per Sector of Activity

Sector	Allocation of Hours Worked by Sector (%)	
	All Ironworkers in Quebec	Participants in the Occupational Analysis Workshop
Residential	3%	10%
Institutional and commercial	41%	60%
Civil engineering and roads	25%	10%
Industrial	31%	20%

It can be observed that, on average, the work time allocation of the meeting participants differs somewhat from that of ironworkers in Quebec as a whole. In both cases, the institutional and commercial sector ranks first, but its preponderance is greater for workshop participants (60% rather than 41% for ironworkers as a whole). The work time in the residential sector is greater for the participants (12%) than for ironworkers as a whole (3%). Moreover, the work time in the civil engineering and roads sector and in the industrial sector is less for the participants than for ironworkers as a whole.

6. Commission de la construction du Québec, *Careers – Construction*, 2013-2014 edition.

1.4 FIELD OF PRACTICE

The trade's field of practice is the construction industry. The Act respecting labour relations, vocational training and workforce management in the construction industry (R.S.Q., c. R-20) defines construction as follows:

[...] the foundation, erection, maintenance, renewal, repair, alteration and demolition work on buildings and civil engineering works carried out on the job site itself and vicinity including the previous preparatory work on the ground;

In addition, the word "construction" includes the installation, repair and maintenance of machinery and equipment, work carried out in part on the job site itself and in part in the shop, moving of buildings, transportation of employees, dredging, turfing, cutting and pruning of trees and shrubs and laying out of golf courses, but solely in the cases determined by regulation.

1.5 LAWS AND REGULATIONS

Ironworkers in the construction industry are subject to:

- the Act respecting labour relations, vocational training and workforce management in the construction industry (R.S.Q., c. R-20);
- the Regulation respecting the vocational training of workforce in the construction industry (R-20, r.6.2);
- the four sector-based collective agreements of the construction industry;
- the National Building Code – Canada 2005 (NBC);
- the Quebec Construction Code, Chapter I, "Building";
- the Act Respecting Occupational Health and Safety (R.S.Q., c. S-2.1);
- the Safety Code for the construction industry (R.Q. c. S-2.1, r.6);
- municipal by-laws, if applicable.

Moreover, the participants mentioned that some companies add internal regulations, particularly regarding safety, that frequently exceed the requirements of laws and legal regulations.

1.6 WORKING CONDITIONS

The following information provides an overview of the conditions and context of the work of ironworkers, as commented by the participants in the occupational analysis workshop. To obtain up-to-date and complete information that has legal effect, it is necessary to refer to the four collective agreements of the construction industry sectors.

Salary⁷

The proportion of ironworkers who declared at least 500 hours in 2012 is estimated at 83%. In addition, since late July 2013, the daytime hourly wage of a journeyman ironworker was as follows:

- Industrial: \$35.84
- Institutional and commercial: \$35.84
- Civil engineering and roads: \$35.92
- Light residential: \$33.53
- Heavy residential: \$35.76

Vacations and time off⁸

Mandatory annual holidays of four weeks – two weeks in summer and two in winter at fixed periods determined in collective agreements – are the general rule in the construction industry. To avoid penalizing employers and employees experiencing special constraints, the industry's four collective agreements allow certain possibilities for changing the vacation periods prescribed by the general rule.

To these vacation periods are added eight not worked statutory holidays, as well as a lump sum for sick leaves not otherwise paid.

7. The salary data are taken from the document *Careers – Construction*, 2013-2014 edition, published by the Commission de la construction du Québec, and from the collective agreements of the construction industry sectors.

8. The data on vacations and time off, the pension plan and insurance are taken from the document *La construction au Québec : c'est bien plus payant!*, published in 2009 by the Commission de la construction du Québec.

Pension plan

Construction industry workers have access to a pension plan. They retain their eligibility for this pension plan throughout their career in construction, even if they change employer, trade or sector.

Insurance

The group insurance plan (medications, illness, disability, death) is fully paid by employers. Workers (and their families, as the case may be) are eligible for it so long as they remain active in the construction industry and work the required number of hours, whether or not they change employer.

Physical requirements

The participants agree that the work is physically demanding for various reasons. For example, in many cases, work done in spaces difficult to access does not make it possible to use all the equipment that would make it easier to handle the elements, so that the workers have to handle them manually and thus lift substantial loads. Additionally, given that the work often takes place in awkward positions, ironworkers must be supple and flexible to perform their tasks. All the work done by ironworkers is therefore physically demanding and requires good physical condition, the endurance to work for long hours and maintain constant physical effort, as well as the strength to lift certain components to be assembled, tools or equipment. Moreover, ironworkers often have to work outdoors and are thus subject to difficult weather conditions at times.

Work schedules

A 40-hour workweek from Monday to Friday is the general rule in all construction industry sectors. The daily limit is 8 hours a day, except in the light residential sector, where it can be up to 10 hours within a 40-hour week.

In the civil engineering and roads sector, the regular work hours of any employee are 40 hours a week from Monday to Friday, with a daily limit of 8 hours. However, in some cases, for example for road and excavation work, the work week is 45 hours from Monday to Friday, with a daily limit of 9 or 10 hours from Monday to Thursday and of 5 hours on Friday.

In addition, when work takes place in remote areas, for example north of the 55th parallel, the regular work week is 50 hours from Monday to Friday, within a daily limit of 10 hours.

To avoid penalizing employers and employees experiencing special constraints, the industry's four collective agreements allow many possibilities for changing the schedule prescribed by the general rule: compressed schedule, schedule shift, etc. These special schedules confer flexibility to the work schedules in effect in the construction industry.

The residential sector work is generally done in the daytime and on weekdays. In the civil engineering and roads sector, and particularly in the industrial sector, work schedules may vary considerably and may total up to 80 hours a week in some cases. Overtime is thus not rare, for example when deadlines are tight (as is almost always the case), when work is done in a manufacturing environment and requires a plant shutdown, etc. Moreover, in the case of outdoor work, the work schedule largely depends on weather conditions.

For institutional and commercial work, the regular workweek is 40 hours from Monday to Friday, 8 hours a day. In addition, when work takes place in remote areas, for example north of the 55th parallel, the regular workweek is 45 hours, within a daily limit of 9 hours.

Lastly, ironworkers may also have to work in other regions than their own. The length of stays may vary depending on the work to be done. However, according to the participants, an ironworker who would want to work only in his region could still practice the trade, as long as he resides near large urban centres.

1.7 JOB MARKET ENTRY CONDITIONS

To obtain the competency certificate-apprentice in the trade, candidates must present to the CCQ the original version of an academic transcript or apprenticeship transcript attesting that they have obtained the DEP – montage structural et architectural, as well as a guarantee of employment from an employer registered with the CCQ for at least 150 hours within a period of not more than three consecutive months⁹.

9. Other conditions than those listed here may apply. For a complete list of entry conditions for this trade, see the Act respecting labour relations, vocational training and workforce management in the construction industry (R.S.Q., c. R-20). The CCQ's website may also be consulted: http://www.ccq.org/en/DevenirTravailleur/E_CertificatsCompetence.

Although the construction industry favours graduates for access to the trade, labour shortages may at times make it necessary to give non-graduates access to the ironworker trade. Thus, candidates without a diploma are eligible to obtain a competency certificate-apprentice only in the event of a labour shortage and must¹⁰:

- supply proof that they have the academic prerequisites for the program leading to a DEP in the trade referred to in the application or pledge, by signing a consent letter, to take the necessary training to obtain those academic prerequisites;
- present, during a labour-pool opening, a guarantee of employment produced by an employer registered with the CCQ, for at least 150 hours over a period of at most three consecutive months.

The apprentice ironworker must have completed three apprenticeship periods of 2,000 hours each (for a total of 6,000 hours) in his trade, in order to be eligible for the provincial qualification examination, success in which leads to obtaining the competency certificate-journeyman for the trade. Credits are paid into the apprenticeship record book of an apprentice ironworker who has obtained his diploma.

Of the 11 meeting participants, only one has obtained the DEP – montage structural et architectural. However, a few of them have followed training programs in related fields, for example in welding and fitting.

Certain qualities are sought by employers hiring new ironworkers. The following list presents the main qualities, in the order they were mentioned and not in order of importance:

- interest in doing the work and in learning;
- rigour and workmanship;
- punctuality and diligence;
- mastery of work techniques (welding, rigging, lifting, etc.);
- sense of responsibility (e.g.: following safety rules);
- etc.

10. Ibid.

1.8 PLACE OF WOMEN IN THE TRADE

Section 126.0.1 of the Act respecting labour relations, vocational training and workforce management in the construction industry pertains to women's access to the construction industry: "The Commission, after consultation with the Commission des droits de la personne et des droits de la jeunesse, shall develop measures to favour the access of women to and their maintenance and greater representation on the labour market in the construction industry."

In 2012, according to the CCQ¹¹, 25 women were practicing the trade out of a total of 3,450 ironworkers, i.e., 0.71%.

Some of the participants mentioned that given the safety rules and the equipment that must be used to help lift very heavy loads, no reason would prevent a woman from doing the work if she wanted to.

1.9 CAREER PROSPECTS

The career prospects of ironworkers are similar to those of all construction industry workers. Thus, after a variable number of years of experience (depending on the context and persons), they may become foremen, project managers, superintendents, etc. Other possibilities are entrepreneurship, teaching future ironworkers, and preventive functions in matters of health and safety.

1.10 DEVELOPMENT OF THE TRADE

The main changes that have occurred in recent years and that, according to the participants, are likely to be maintained and even increase, are the following:

- The main change is of course the merger of the trades of ornamental ironworker and structural steel erector, which will require, for persons interested in practicing their activities in both fields, an adaptation to work processes, task specifics, etc.

11. Commission de la construction du Québec, *Careers – Construction*, 2013-2014 edition.

- The equipment is constantly developing, whether for erection and assembly or for elements already installed. The changes are frequent and may become more and more so.
- New materials are appearing, such as carbon fibre, FRP – fibre reinforced polymer, fibreglass, etc.
- More and more elements arrive pre-assembled, which reduces the work to be done since less assembly is required, but also makes it necessary to lift and move objects of ever-greater size and weight. So the rigging and lifting techniques and equipment have to be adapted.

1.11 IMPACT OF ENVIRONMENTAL STANDARDS ON THE PRACTICE OF THE TRADE

According to the participants, the application of environmental standards may vary from one construction site to another. However, the participants generally agreed that the work of ironworkers has been modified by the introduction of certain environmental standards. The participants referred particularly to standards for eliminating waste oils and fluids and their containers, for preventing spills, and for sorting recyclable or reusable waste materials.

2. WORK DESCRIPTION

2.1 TASKS AND OPERATIONS

List of tasks

The following list presents the main tasks performed by ironworkers. The order in which the tasks are presented does not necessarily reflect their importance in the trade.

Task 1	Mobilize a construction site
Task 2	Assemble the lifting device
Task 3	Unload the equipment
Task 4	Rig elements
Task 5	Install stationary scaffolds
Task 6	Install stairways and walkways
Task 7	Install protective elements
Task 8	Install covering elements
Task 9	Erect structural elements
Task 10	Erect prefabricated elements (concrete, steel, modules, etc.)
Task 11	Modify, repair and reinforce structural or architectural elements
Task 12	Dismantle structural or architectural elements

Table of tasks and operations

During the workshop, a table of tasks and operations performed by ironworkers was presented to the participants. Following discussions, changes were made to the table. The final version is presented in the following pages.

Table 2.1 Tasks and Operations

TASKS	OPERATIONS					
1. MOBILIZE A CONSTRUCTION SITE	1.1 Receive instructions	1.2 Secure the work area	1.3 Install a rest area	1.4 Find out about prevention programs	1.5 Prepare work tools and equipment	
2. ASSEMBLE THE LIFTING DEVICE	2.1 Receive instructions	2.2 Secure the work area	2.3 Stabilize the lifting device	2.4 Help the operator to assemble boom sections and other components	2.5 If applicable, install and lift ladder jack scaffolds (gins)	2.6 Add rigging components, if applicable
	2.7 Check the operation of mechanisms and other elements, if applicable	2.8 Signal and assist in moving the lifting device	2.9 Stabilize the lifting device for the work			
3. UNLOAD THE EQUIPMENT	3.1 Receive instructions	3.2 Secure the work area	3.3 Indicate the unloading location to the operator	3.4 Lay out the blocking elements on the ground	3.5 Unchain the materials	3.6 Install slings
	3.7 Signal the operations to the operator or driver	3.8 Escort incoming and outgoing materials	3.9 Unhook the lifting device	3.10 Sort the materials according to the work sequence		
4. RIG ELEMENTS	4.1 Receive instructions	4.2 Secure the work area	4.3 Detect mandatory lifting points, if applicable	4.4 Install the rigging system and accessories	4.5 Determine the element's centre of gravity	4.6 Sling the element
	4.7 Signal the operations	4.8 Stabilize the element				

TASKS	OPERATIONS					
5. INSTALL STATIONARY SCAFFOLDS	5.1 Receive instructions	5.2 Secure the work area	5.3 Level the base	5.4 Install jacks	5.5 Assemble posts and bracings	5.6 Align the sections with the base
	5.7 Place planks, platforms or stairs in the sections	5.8 Fasten the sections to the building's anchor points	5.9 Install the safety devices			
6. INSTALL STAIRWAYS AND WALKWAYS	6.1 Receive instructions	6.2 Secure the work area and protect the work already done	6.3 Read the plans or drawings and the specifications	6.4 Select the tools and equipment	6.5 Compare the data of plans or drawings with those of the elements and site	6.6 Plan the work
	6.7 Position the stringers	6.8 Position the bracings and landings	6.9 ¹² Install the steps and risers	6.10 Do the final squaring and make level	6.11 Install handrails, ramps and nosings	6.12 Install anchors
	6.13 Weld, grind	6.14 Do primer or paint touch-ups, if applicable	6.15 Polish, if applicable (inox)	6.16 Make sure of the quality of your work	6.17 Store the tools and equipment	
7. INSTALL PROTECTIVE ELEMENTS	7.1 Receive instructions	7.2 Read the plans or drawings and the specifications	7.3 Select the tools and equipment	7.4 Secure the work area and protect the work already done	7.5 Compare the data of plans or drawings with those of the elements and site	7.6 Plan the work
	7.7 Trace, if applicable	7.8 Assemble, position and align the elements	7.9 Make level and square	7.10 Weld, glue, screw, bolt	7.11 Do primer or paint touch-ups, if applicable	7.12 Make sure of the quality of your work
	7.13 Store the tools and equipment					

12. In some cases, the order of operations 6.9 and 6.10 is inverted.

TASKS	OPERATIONS					
8. INSTALL COVERING ELEMENTS	8.1 Receive instructions	8.2 Read the plans or drawings and the specifications	8.3 Select the tools and equipment	8.4 Secure the work area and protect the work already done	8.5 Compare the data of plans or drawings with those of the elements and site	8.6 Plan the work
	8.7 Trace, if applicable	8.8 Assemble, position and align the elements	8.9 Make level and square	8.10 Weld, glue, screw, anchor	8.11 Do primer or paint touch-ups, if applicable	8.12 Polish, if applicable (inox)
	8.13 Make sure of the quality of your work	8.14 Store the tools and equipment				
9. ERECT STRUCTURAL ELEMENTS	9.1 Receive instructions	9.2 Read the plans or drawings	9.3 Select the tools and equipment	9.4 Secure the work area	9.5 Install shims on the anchor base	9.6 Install vertical safety cables
	9.7 Erect columns	9.8 Stabilize the columns	9.9 Install safety devices	9.10 Assemble the structure	9.11 Install temporary guys	9.12 Put bridging packets in place
	9.13 Bolt the structure: align, point, bore or drill	9.14 Install struts, canopies and roof opening supports	9.15 Align and make plumb	9.16 Tighten and tension the bolts	9.17 Fasten the elements in final position: gouge, chamfer, weld, grind	9.18 Do primer or paint touch-ups, if applicable
	9.19 Extend and fasten the metal bridging	9.20 Make sure of the quality of your work	9.21 Store the tools and equipment			
10. ERECT PREFABRICATED ELEMENTS (CONCRETE, STEEL, MODULES, ETC.)	10.1 Receive instructions	10.2 Select the tools and equipment	10.3 Secure the work area	10.4 Install required scaffolds, if applicable	10.5 Put the shims in place	10.6 Handle the element
	10.7 Position and stabilize the element (hand winches)	10.8 Fasten permanently	10.9 Make sure of the quality of your work	10.10 Store the tools and equipment		

TASKS	OPERATIONS					
11. MODIFY, REPAIR AND REINFORCE STRUCTURAL OR ARCHITECTURAL ELEMENTS	11.1 Receive instructions	11.2 Select the tools and equipment	11.3 Secure the work area	11.4 Plan the work	11.5 Install safety devices on the elements	11.6 Remove bridging, if applicable
	11.7 Stabilize the elements, if applicable	11.8 Identify and remove elements, if applicable	11.9 Modify, repair, reinforce elements	11.10 Replace elements	11.11 Put removed elements back, if applicable	11.12 Do the finishing
	11.13 Put the bridging back, if applicable	11.14 Make sure of the quality of your work	11.15 Store the tools and equipment			
12. DISMANTLE STRUCTURAL OR ARCHITECTURAL ELEMENTS	12.1 Receive instructions	12.2 Select the tools and equipment	12.3 Secure the work area	12.4 Install the safety devices	12.5 Remove bridging, if applicable	12.6 Stabilize the elements (with guys, if applicable)
	12.7 Install scaffolds, if applicable	12.8 Identify the elements according to guidelines	12.9 Partially unbolt the elements or cut the rivets	12.10 Sling the elements	12.11 Unbolt, cut the rivets completely or gouge the welds	12.12 Receive the elements on the ground
	12.13 Load the elements on a carrier	12.14 Chain the elements	12.15 Make sure of the quality of your work	12.16 Store the tools and equipment		

2.2 OPERATIONS, SUB-OPERATIONS AND CLARIFICATIONS

In the following pages are presented the sub-operations related to most of the operations¹³, as well as a few clarifications made by the participants.

Table 2.2 Sub-Operations and Operation Clarifications

TASK 1 MOBILIZE A CONSTRUCTION SITE		
<i>Operations</i>	<i>Sub-Operations</i>	<i>Clarifications</i>
1.1 Receive instructions		Instructions – written or verbal – may pertain to the following aspects: health and safety hazards, work schedules, construction site operating rules and emergency rules, work location, work description, positioning traffic and storage areas (equipment, dangerous products, etc.) as well as supply stations, etc.
1.2 Secure the work area	1.2.1 Establish traffic and access paths 1.2.2 Delimit the work area 1.2.3 Establish a safety perimeter	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc.
1.3 Install a rest area	1.3.1 Install a construction trailer or any similar facility 1.3.2 Stabilize and level the trailer 1.3.3 Ensure the availability of utilities (water, electricity, toilets, etc.)	
1.4 Find out about prevention programs	1.4.1 Attend the welcoming session 1.4.2 Read the programs 1.4.3 Learn about each worker's role	These are the prevention programs of the project manager, general contractor and employer.
1.5 Prepare work tools and equipment	1.5.1 Unload the tools and equipment 1.5.2 Install containers of tools, equipment, etc. 1.5.3 Allocate tools and equipment on the construction site 1.5.4 Make sure all necessary tools and equipment are present 1.5.5 Proceed with the inventory, if applicable	

13. The order of operations may vary according to the company's organization.

TASK 2 ASSEMBLE THE LIFTING DEVICE		
Operations	Sub-Operations	Clarifications
2.1 Receive instructions	2.1.1 Make sure to have the lifting devices' conformity certification 2.1.2 Learn about the lifting plans, if applicable	Instructions – written or verbal – may pertain to the following aspects: health and safety hazards, work location, work description, etc.
2.2 Secure the work area	2.2.1 Delimit the work area 2.2.2 Establish a safety perimeter 2.2.3 Detect hazards and obstacles around the work area	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc.
2.3 Stabilize the lifting device	2.3.1 Determine the best location to position the lifting device 2.3.2 Make sure that the soil condition will make it possible to stabilize the appliance 2.3.3 Anchor the appliance in the concrete and fasten the winch, if applicable 2.3.4 Anchor wooden mats under the outriggers, if applicable	The installation of certain types of lifting devices requires validation by the person responsible for safety.
2.4 Help the operator to assemble boom sections and other components	2.4.1 Apply the assembly procedure 2.4.2 Follow the operator's directions	
2.5 If applicable, install and lift ladder jack scaffolds (gins)		
2.6 Add rigging components, if applicable	2.6.1 Consider the nature of the work 2.6.2 Change the block, if applicable	This operation is performed in cooperation with the lifting device operator.
2.7 Check the operation of mechanisms and other elements, if applicable		For this operation, the ironworker must ask the device operator to perform lifting tests and verify that everything is proceeding as planned. For his part, the ironworker can then verify the operation, for example, of the span limiter, anemometer, anti-two block, etc.

TASK 2 ASSEMBLE THE LIFTING DEVICE		
Operations	Sub-Operations	Clarifications
2.8 Signal and assist in moving the lifting device		To avoid any confusion and eventually accidents, it is very important that a single person be responsible for signalling. The ironworker must therefore have a good knowledge of the lifting signals and of the operation of radio devices. He must be highly vigilant to prevent accidents.
2.9 Stabilize the lifting device for the work		
TASK 3 UNLOAD THE EQUIPMENT		
Operations	Sub-Operations	Clarifications
3.1 Receive instructions	3.1.1 Determine the locations for placing the elements	At this stage, instructions are verbal and pertain essentially to the locations where the materials should be allocated. Moreover, a lifting plan may be necessary for unloading. The ironworker must then learn about it and follow it.
3.2 Secure the work area	3.2.1 Delimit the work area 3.2.2 Establish a safety perimeter 3.2.3 Detect hazards and obstacles around the work area	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc.
3.3 Indicate the unloading location to the operator		The choice of location is first communicated by the foreman to the ironworker.
3.4 Lay out the blocking elements on the ground		Blocking elements placed on the ground facilitate the unloading. These are generally wooden pieces of 4 in. x 4 in.
3.5 Unchain the materials	3.5.1 Remove the chain 3.5.2 Check the load stability	While the chain is being removed, for safety reasons ironworkers must remain at a distance from the load.
3.6 Install slings	3.6.1 Choose the slings 3.6.2 Check the slings' condition 3.6.3 Install softeners, if applicable 3.6.4 Install a hauling cable, if applicable	

TASK 3 UNLOAD THE EQUIPMENT		
Operations	Sub-Operations	Clarifications
3.7 Signal the operations to the operator or driver	3.7.1 Ensure good visibility and that you are visible 3.7.2 Make sure a single person signals	To avoid any confusion and eventually accidents, it is very important that a single person be responsible for signalling. The ironworker must therefore have a good knowledge of the lifting signals and of the operation of radio devices. He must be highly vigilant to prevent accidents.
3.8 Escort incoming and outgoing materials		Depending on the type of materials, this operation is performed, for example, using a hauling cable or while keeping one hand on the materials.
3.9 Unhook the lifting device		The operation is performed once the materials are placed on support blocks and the ironworker has made sure it is stable. At the moment of unhooking the lifting device, as a safety measure ironworkers must remain at a distance from the load.
3.10 Sort the materials according to the work sequence	3.10.1 Separate structural from architectural elements 3.10.2 Group similar elements together 3.10.3 Number the elements, if applicable 3.10.4 Mark the centre of the elements, if applicable	
TASK 4 RIG ELEMENTS		
Operations	Sub-Operations	Clarifications
4.1 Receive instructions	4.1.1 Learn about the lifting plan, if applicable	The instructions pertain mainly to the elements' weight; a lifting plan may be provided in certain cases.
4.2 Secure the work area	4.2.1 Delimit the work area 4.2.2 Plan for the path and movements of elements to be moved 4.2.3 Detect hazards and obstacles around the work area 4.2.4 Establish the method of communication to be used	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc.
4.3 Detect mandatory lifting points, if applicable	4.3.1 Check the presence of lifting points on the element	

TASK 4 RIG ELEMENTS		
Operations	Sub-Operations	Clarifications
4.4 Install the rigging system and accessories	4.4.1 Install shackles 4.4.2 Install lift beams, if applicable	
4.5 Determine the element's centre of gravity	4.5.1 Measure the element 4.5.2 Mark the centre	
4.6 Sling the element	4.6.1 Choose slings of appropriate length and size for the work 4.6.2 Check the slings' condition 4.6.3 Install the slings	
4.7 Signal the operations		To avoid any confusion and eventually accidents, it is very important that a single person be responsible for signalling. The ironworker must therefore have a good knowledge of the lifting signals and of the operation of radio devices. He must be highly vigilant to prevent accidents.
4.8 Stabilize the element		To stabilize the element, the ironworker must take its centre of gravity into account and make sure the slinging is always balanced.
TASK 5 INSTALL STATIONARY SCAFFOLDS		
Operations	Sub-Operations	Clarifications
5.1 Receive instructions	5.1.1 Verify the availability and content of the installation plan 5.1.2 Pay attention to specific points	Instructions may pertain, for example, to the following aspects: health and safety hazards, work location, work description, etc.
5.2 Secure the work area	5.2.1 Delimit the work area 5.2.2 Verify the obstacles 5.2.3 Verify whether superimposed work will be done 5.2.4 Determine the best location for positioning the scaffold 5.2.5 Make sure the soil condition will make it possible to level the scaffold	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc.
5.3 Level the base		This operation is performed using a level (laser or other).

TASK 5 INSTALL STATIONARY SCAFFOLDS		
Operations	Sub-Operations	Clarifications
5.4 Install jacks	5.4.1 Assemble the first section 5.4.2 Align the jacks 5.4.3 Ensure that the base is solid and stable	
5.5 Assemble posts and bracings		It is important always to put the posts on the same side.
5.6 Align the sections with the base	5.6.1 Make and install the anchor points 5.6.2 Align the sections	The alignment may be done "by eye" or using piano wire.
5.7 Place planks, platforms or stairs in the sections		The ironworker must make sure to use only planks certified for that purpose.
5.8 Fasten the sections to the building's anchor points	5.8.1 Fasten the anchor points, if applicable 5.8.2 Position the sections 5.8.3 Secure the sections to the anchor points	
5.9 Install the safety devices ¹⁴		These are devices such as gates, kick plates, etc.
TASK 6 INSTALL STAIRWAYS AND WALKWAYS		
Operations	Sub-Operations	Clarifications
6.1 Receive instructions		Instructions may pertain, for example, to the following aspects: health and safety hazards, work location, work description, etc.
6.2 Secure the work area and protect the work already done	6.2.1 Delimit the work area 6.2.2 Establish a safety perimeter 6.2.3 Detect hazards and obstacles around the work area 6.2.4 Prepare the protective equipment 6.2.5 Install devices for protecting the work already done	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc. It is important to protect the work already done (windows, walls, materials, etc.), particularly during welding or grinding work.
6.3 Read the plans or drawings and the specifications	6.3.1 Interpret the cartridge information 6.3.2 Interpret the legend 6.3.3 Find the reference dimension 6.3.4 Interpret the symbols in use 6.3.5 Distinguish the significant data 6.3.6 Consult a list of materials	This may be the general construction site plan, the specific plan for work to be done, freehand drawings, shop drawings, etc.

14. In addition, as a safety measure, the ironworker must always check the scaffold's conformity before climbing to work on it.

TASK 6 INSTALL STAIRWAYS AND WALKWAYS		
Operations	Sub-Operations	Clarifications
6.4 Select the tools and equipment	6.4.1 Prepare a list of materials 6.4.2 Determine the necessary quantities 6.4.3 Group the materials together 6.4.4 Determine the installation method 6.4.5 Gather the tools and equipment 6.4.6 Make sure the tools and equipment are operating well	
6.5 Compare the data of plans or drawings with those of the elements and site		In the event of a discrepancy between plans or drawings and actual data, the ironworker must, if applicable, determine the changes to make to the plans or drawings and have those changes approved by the person responsible. It is extremely important to detect any discrepancy between plan data and actual data. An error or lack of precision at the time of the comparison can have a major impact on the duration of the work. Lastly, the ironworker must determine a reference point (centre line, benchmark, etc.) for doing the work.
6.6 Plan the work	6.6.1 Determine the sequence of work to be done 6.6.2 Identify the standards to be met 6.6.3 Assess the work's importance	
6.7 Position the stringers	6.7.1 Check the height of stairways and landings 6.7.2 Mark the landings and stairways 6.7.3 Check the wall's composition and the finished floor's height 6.7.4 Mark the position of stringers and landings	
6.8 Position the bracings and landings		At this stage, it is necessary to check the spacing between bracings as well as their height.
6.9 Install the steps and risers	6.9.1 Position the steps and risers according to the markings 6.9.2 Consider the end blocks 6.9.3 Point the parts	A stairway's first step will be installed at the end, otherwise it could hinder the anchors' installation (6.12). It is important, at this stage, not to damage the stringers, particularly when they are visible once the installation is completed.

TASK 6 INSTALL STAIRWAYS AND WALKWAYS		
Operations	Sub-Operations	Clarifications
6.10 Do the final squaring and make level		The ironworker must make sure to obtain the desired clearance between landings and risers and, for example, the building's wall.
6.11 Install handrails, ramps and nosings		The ironworker must make sure of the presence of a nailing base for the installation of handrails. The standards for the following aspects may vary according to the types of construction sites (institutional, commercial, etc.), the municipalities, etc.: - the height of railings; - the distance between cross beams; - handrail clearance; - the height and dimensions of stairs; - etc.
6.12 Install anchors		The anchors may be, for example, bolts, lag screws, etc. They must be installed at the appropriate depth, particularly if they remain visible once the installation is completed. So the holes' depth must be checked before the installation, to ensure sufficient projection.
6.13 Weld, grind	6.13.1 Choose the filler metal 6.13.2 Choose the type of grinder according to the metal 6.13.3 Apply the welding and grinding techniques 6.13.4 Remove excess slag, particularly under landings	During this operation, it is important to protect adjacent elements such as mirrors, windows, etc. In addition, care must be taken not to leave traces of rust on balconies and other fibreglass elements that would be wet.
6.14 Do primer or paint touch-ups, if applicable		Touch-ups must be done meticulously, with a primer or paint, while using a brush of good quality.
6.15 Polish, if applicable (inox)		This operation is performed only for stainless steel elements. Choosing an appropriate abrasive is important for obtaining a satisfactory result.
6.16 Make sure of the quality of your work	6.16.1 Verify the work done 6.16.2 Make corrections, if applicable 6.16.3 Have your work approved by the person responsible	The person responsible may be the foreman, engineer, client, employer, etc.

TASK 6 INSTALL STAIRWAYS AND WALKWAYS		
Operations	Sub-Operations	Clarifications
6.17 Store the tools and equipment	6.17.1 Sort the materials 6.17.2 Dispose of unrecyclable materials 6.17.3 Recover useful materials 6.17.4 Clean the tools 6.17.5 Store materials and tools at the appropriate locations 6.17.6 Signal the loss or failure of tools or equipment	
TASK 7 INSTALL PROTECTIVE ELEMENTS		
Operations	Sub-Operations	Clarifications
7.1 Receive instructions		Instructions may pertain, for example, to the following aspects: health and safety hazards, work location, work description, etc.
7.2 Read the plans or drawings and the specifications	7.2.1 Interpret the cartridge information 7.2.2 Interpret the legend 7.2.3 Find the reference dimension 7.2.4 Interpret the symbols in use 7.2.5 Distinguish the significant data 7.2.6 Consult a list of materials	This may be the general construction site plan, the specific plan for work to be done, freehand drawings, shop drawings, etc.
7.3 Select the tools and equipment	7.3.1 Prepare a list of materials 7.3.2 Determine the necessary quantities 7.3.3 Group the materials together 7.3.4 Gather the tools and equipment 7.3.5 Make sure the tools and equipment are operating well	
7.4 Secure the work area and protect the work already done	7.4.1 Delimit the work area 7.4.2 Establish a safety perimeter 7.4.3 Detect hazards and obstacles around the work area 7.4.4 Prepare the protective equipment 7.4.5 Install devices for protecting the work already completed	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc. It is important to protect the work already done (windows, walls, materials, etc.), particularly during welding or grinding work.

TASK 7 INSTALL PROTECTIVE ELEMENTS		
Operations	Sub-Operations	Clarifications
7.5 Compare the data of plans or drawings with those of the elements and site		In the event of a discrepancy between plans or drawings and actual data, the ironworker must, if applicable, determine the changes to make to the plans or drawings and have those changes approved by the person responsible. It is extremely important to detect any discrepancy between plan data and actual data. An error or lack of precision at the time of the comparison can have a major impact on the duration of the work. Lastly, the ironworker must determine a reference point (centre line, benchmark, etc.) for doing the work.
7.6 Plan the work	7.6.1 Determine the sequence of work to be done 7.6.2 Identify the standards to be met 7.6.3 Assess the importance of the work	In addition to the sequence of work, ironworkers must, in collaboration with their co-workers, determine how the work will proceed, what tasks will be assigned to each team member, etc.
7.7 Trace, if applicable	7.7.1 Measure 7.7.2 Mark the reference points for positioning the elements 7.7.3 Plumb the work lines 7.7.4 Establish the levels of elements 7.7.5 Mark the elevations if required 7.7.6 Pull the lines 7.7.7 Check the conformity with the plan	
7.8 Assemble, position and align the elements	7.8.1 Learn about the assembly method 7.8.2 Cut the parts if necessary 7.8.3 Drill holes if necessary	
7.9 Make level and square		
7.10 Weld, glue, screw, bolt	7.10.1 Install suspension and anchoring elements 7.10.2 Do grinding or deflashing work 7.10.3 Anchor the parts	The ironworker must make sure to meet bolting (e.g.: tightening torque, sequence) and welding standards.

TASK 7 INSTALL PROTECTIVE ELEMENTS		
Operations	Sub-Operations	Clarifications
7.11 Do primer or paint touch-ups, if applicable	7.11.1 Do touch-ups 7.11.2 Install plastic trims 7.11.3 Do polishing work (welding points)	Touch-ups must be done meticulously, with a primer or paint, while using a brush of good quality.
7.12 Make sure of the quality of your work	7.12.1 Verify the work done 7.12.2 Make corrections, if applicable 7.12.3 Have your work approved by the person responsible	The person responsible may be the foreman, engineer, client, employer, etc.
7.13 Store the tools and equipment	7.13.1 Sort the materials 7.13.2 Dispose of unrecyclable materials 7.13.3 Recover the useful materials 7.13.4 Clean the tools 7.13.5 Store the materials and tools at the appropriate locations 7.13.6 Report the loss or failure of tools or equipment	
TASK 8 INSTALL COVERING ELEMENTS		
Operations	Sub-Operations	Clarifications
8.1 Receive instructions		Instructions may pertain, for example, to the following aspects: health and safety hazards, work location, work description, etc.
8.2 Read the plans or drawings and the specifications	8.2.1 Interpret the cartridge information 8.2.2 Interpret the legend 8.2.3 Find the reference dimension 8.2.4 Interpret the symbols in use 8.2.5 Distinguish the significant data 8.2.6 Consult a list of materials	This may be the general construction site plan, the specific plan for work to be done, freehand drawings, shop drawings, etc.
8.3 Select the tools and equipment	8.3.1 Prepare a list of materials 8.3.2 Determine the necessary quantities 8.3.3 Group the materials together 8.3.4 Gather the tools and equipment 8.3.5 Make sure the tools and equipment are operating well	
8.4 Secure the work area and protect the work already done	8.4.1 Delimit the work area 8.4.2 Establish a safety perimeter 8.4.3 Detect hazards and obstacles around the work area 8.4.4 Prepare the protective equipment 8.4.5 Install devices for protecting the work already completed	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc. It is important to protect the work already done (windows, walls, materials, etc.), particularly during welding or grinding work.

TASK 8 INSTALL COVERING ELEMENTS		
Operations	Sub-Operations	Clarifications
8.5 Compare the data of plans or drawings with those of the elements and site	8.5.1 Measure the site's elements and components 8.5.2 Check the squaring and levelling 8.5.3 Check the materials of which the site's components are made 8.5.4 Compare these data with the ones on plans or drawings	In the event of a discrepancy between plans or drawings and actual data, the ironworker must, if applicable, determine the changes to make to the plans or drawings and have those changes approved by the person responsible. It is extremely important to detect any discrepancy between plan data and actual data. An error or lack of precision at the time of the comparison can have a major impact on the duration of the work. Lastly, the ironworker must determine a reference point (centre line, benchmark, etc.) for doing the work.
8.6 Plan the work	8.6.1 Determine the sequence of work to be done 8.6.2 Identify the standards to be met 8.6.3 Assess the importance of the work 8.6.4 Ensure that the premises are clean	In addition to the sequence of work, ironworkers must, in collaboration with their co-workers, determine how the work will proceed, what tasks will be assigned to each team member, etc.
8.7 Trace, if applicable		
8.8 Assemble, position and align the elements	8.8.1 Ensure that the receiving surface is clean 8.8.2 Ensure that the tracing is exact 8.8.3 Check the position of anchors 8.8.4 Match (under the joints) the colour of the receiving surface with that of the siding 8.8.5 Ensure that the siding is protected	
8.9 Make level and square		This operation is essential for the joints between panels to be compliant and homogeneous.
8.10 Weld, glue, screw, anchor	8.10.1 Install suspension and anchoring elements 8.10.2 Do grinding or deflashing work 8.10.3 Anchor the parts	This operation requires special attention to avoid damage to work already done. In addition, the ironworker must make sure to meet bolting (e.g.: tightening torque, sequence) and welding standards.

TASK 8 INSTALL COVERING ELEMENTS		
<i>Operations</i>	<i>Sub-Operations</i>	<i>Clarifications</i>
8.11 Do primer or paint touch-ups, if applicable		Touch-ups must be done with precision because this is the definitive work.
8.12 Polish, if applicable (inox)		This operation is performed only for stainless steel elements. Choosing an appropriate abrasive is important for obtaining a satisfactory result. After the polishing, the elements must be cleaned with an appropriate product for the type of material.
8.13 Make sure of the quality of your work	8.13.1 Verify the work done 8.13.2 Make corrections, if applicable 8.13.3 Have your work approved by the person responsible	The person responsible may be the foreman, engineer, client, employer, etc. If no person responsible is present on the work site, it may be useful to photograph the final result in order to present it afterward. In addition, it is often necessary to protect the work until approval is received from the person responsible.
8.14 Store the tools and equipment	8.14.1 Dispose of unrecyclable materials 8.14.2 Recover the useful materials 8.14.3 Clean the tools 8.14.4 Store the materials and tools at the appropriate locations 8.14.5 Report the loss or failure of tools or equipment	
TASK 9 ERECT STRUCTURAL ELEMENTS		
<i>Operations</i>	<i>Sub-Operations</i>	<i>Clarifications</i>
9.1 Receive instructions		Instructions may pertain, for example, to the following aspects: health and safety hazards, work location, work description, etc. In addition, the ironworker may have to interpret plans (lifting, assembly, etc.).
9.2 Read the plans or drawings	9.2.1 Interpret the cartridge information 9.2.2 Interpret the legend 9.2.3 Find the reference dimension 9.2.4 Interpret the symbols in use 9.2.5 Distinguish the significant data	

TASK 9 ERECT STRUCTURAL ELEMENTS		
Operations	Sub-Operations	Clarifications
9.3 Select the tools and equipment	9.3.1 Prepare a list of tools and equipment 9.3.2 Determine the necessary quantities 9.3.3 Choose the tools 9.3.4 Choose the rigging equipment 9.3.5 Choose the access equipment (scaffold, platform, etc.) 9.3.6 Gather the tools and equipment 9.3.7 Make sure tools and equipment are in good condition	
9.4 Secure the work area	9.4.1 Delimit the work area 9.4.2 Establish a safety perimeter 9.4.3 Plan for the path and movements of loads to be moved 9.4.4 Detect hazards and obstacles around the work area 9.4.5 Establish the method of communication to be used for lifting operations	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc.
9.5 Install shims on the anchor base	9.5.1 Start at the highest point 9.5.2 Position the shims 9.5.3 Check the elevation of each shim	
9.6 Install vertical safety cables		These are, for example, lifelines, rope grabs, etc. Before installing them, the ironworker must make sure the cables are in good condition.
9.7 Erect columns	9.7.1 Apply attachment and lifting techniques 9.7.2 Position the columns 9.7.3 Ensure that the columns are correctly oriented	
9.8 Stabilize the columns	9.8.1 Install temporary bracings or guys, if applicable 9.8.2 Ensure that the columns are stable and plumb	
9.9 Install safety devices		These devices are installed on or under the beams; they must be temporary posts or steel cables. It is important to follow safety rules. For example, there must be a maximum distance of 40 feet between each post, cables must be at least half an inch in diameter, etc. It is also important to make sure the devices are compliant, in good condition and solidly fastened.

TASK 9 ERECT STRUCTURAL ELEMENTS		
Operations	Sub-Operations	Clarifications
9.10 Assemble the structure	9.10.1 Centre the slings 9.10.2 Use hauling cables 9.10.3 Position the beams and joists 9.10.4 Bolt partially 9.10.5 Install spacers, if applicable	
9.11 Install temporary guys		
9.12 Put bridging packets in place		The bridging packets must be placed approximately one foot from the edge of the structure. It is important to ensure that they are on the correct side and that both ends of the packets are solidly supported.
9.13 Bolt the structure: align, point, bore or drill		It is important to use bolts of appropriate length. Bolting must be done with a sledge hammer and drift pin or bull pin.
9.14 Install struts, canopies and roof opening supports		
9.15 Align and make plumb	9.15.1 Establish centre lines or leader lines 9.15.2 Adjust column feet 9.15.3 Check the verticality of columns	
9.16 Tighten and tension the bolts	9.16.1 Apply the tension recommended by standards 9.16.2 Follow the tightening sequence	
9.17 Fasten the elements in final position: gouge, chamfer, weld, grind	9.17.1 Apply welding, chamfering, etc. techniques 9.17.2 Install contour angle irons on the roof	
9.18 Do primer or paint touch-ups, if applicable		Touch-ups are done at modified or welded locations.
9.19 Extend and fasten the metal bridging	9.19.1 Ensure that the elements can support the weight 9.19.2 Use a marker to indicate roof openings and joists 9.19.3 Trace lines 9.19.4 Cut the openings	

TASK 9 ERECT STRUCTURAL ELEMENTS		
Operations	Sub-Operations	Clarifications
9.20 Make sure of the quality of your work	9.20.1 Ensure that the work is completed and compliant 9.20.2 Have your work verified by your supervisor, if applicable	
9.21 Store the tools and equipment	9.21.1 Dispose of unrecyclable materials 9.21.2 Recover the useful materials 9.21.3 Clean the tools 9.21.4 Store the materials and tools at the appropriate locations 9.21.5 Report the loss or failure of tools or equipment	
TASK 10 ERECT PREFABRICATED ELEMENTS (CONCRETE, STEEL, MODULES, ETC.)		
Operations	Sub-Operations	Clarifications
10.1 Receive instructions		Instructions may pertain, for example, to the following aspects: health and safety hazards, work location, work description, etc. In addition, the ironworker may have to interpret plans (lifting, assembly, etc.).
10.2 Select the tools and equipment	10.2.1 Prepare a list of tools and equipment 10.2.2 Determine the necessary quantities 10.2.3 Choose the tools 10.2.4 Choose the rigging equipment 10.2.5 Choose the access equipment (scaffold, platform, etc.) 10.2.6 Gather the tools and equipment 10.2.7 Make sure the tools and equipment are in good condition	
10.3 Secure the work area	10.3.1 Establish traffic and access paths 10.3.2 Install safety systems on the elements, if applicable 10.3.3 Delimit the work area 10.3.4 Detect hazards and obstacles around the work area 10.3.5 Determine the lifting device's position	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc.
10.4 Install required scaffolds, if applicable	See task 5.	

TASK 10 ERECT PREFABRICATED ELEMENTS (CONCRETE, STEEL, MODULES, ETC.)

Operations	Sub-Operations	Clarifications
10.5 Put the shims in place	10.5.1 Choose appropriate shims 10.5.2 Determine the position of shims 10.5.3 Position the shims 10.5.4 Check the elevation of shims	The shims must be oriented correctly to receive the element.
10.6 Handle the element	10.6.1 Make sure of the element's weight 10.6.2 Use a hauling cable 10.6.3 Signal the lifting operations 10.6.4 Orient the element during lifting	To avoid any confusion and eventually accidents, it is very important that a single person be responsible for signalling. The ironworker must therefore have a good knowledge of the lifting signals and of the operation of radio devices. He must be highly vigilant to prevent accidents.
10.7 Position and stabilize the element (hand winches)	10.7.1 Ensure that the element is level and plumb 10.7.2 Adjust the position of each element so that all the joints are uniform 10.7.3 Install guys, if applicable 10.7.4 Bolt partially or weld temporarily	
10.8 Fasten permanently	10.8.1 Weld, bolt or apply grout 10.8.2 Remove attachment points 10.8.3 Do primer or paint touch-ups, if applicable	In the event that it is necessary to remove lifting shells, the appropriate procedure must be followed.
10.9 Make sure of the quality of your work	10.9.1 Ensure that the work is completed and compliant 10.9.2 Have your work verified by your supervisor, if applicable	
10.10 Store the tools and equipment	10.10.1 Sort the materials 10.10.2 Dispose of unrecyclable materials 10.10.3 Recover the useful materials 10.10.4 Clean the tools 10.10.5 Store the materials and tools at the appropriate locations 10.10.6 Report the loss or failure of tools or equipment	

TASK 11 MODIFY, REPAIR AND REINFORCE STRUCTURAL OR ARCHITECTURAL ELEMENTS

Operations	Sub-Operations	Clarifications
11.1 Receive instructions		Instructions may pertain, for example, to the following aspects: health and safety hazards, work location, work description, etc. In addition, the ironworker may have to interpret plans (lifting, assembly, etc.).
11.2 Select the tools and equipment	11.2.1 Prepare a list of tools and equipment 11.2.2 Determine the necessary quantities 11.2.3 Choose the tools 11.2.4 Choose the rigging equipment 11.2.5 Choose the access equipment (scaffold, platform, etc.) 11.2.6 Gather the tools and equipment 11.2.7 Make sure the tools and equipment are in good condition	
11.3 Secure the work area	11.3.1 Establish traffic and access paths 11.3.2 Delimit the work area 11.3.3 Detect hazards and obstacles around the work area 11.3.4 Determine the lifting device's position	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc.
11.4 Plan the work	11.4.1 Determine the sequence of work to be done 11.4.2 Identify the standards to be met 11.4.3 Assess the importance of the work	
11.5 Install safety devices on the elements		These may be vertical or horizontal lifelines, railings, bracings, etc., depending on the nature of the work. It is also important to ensure that the devices are compliant, in good condition and solidly fastened.
11.6 Remove bridging, if applicable		During bridging removal, it is important to check the position of joists or bridging supports to ensure they are not damaged.
11.7 Stabilize the element, if applicable		To stabilize the elements, it may be necessary, for example, to install temporary guys or columns. The purpose of this operation is to ensure that the elements remain solidly in place and that none will fall during the work.

TASK 11 MODIFY, REPAIR AND REINFORCE STRUCTURAL OR ARCHITECTURAL ELEMENTS

Operations	Sub-Operations	Clarifications
11.8 Identify and remove elements, if applicable	11.8.1 Detect defective or damaged elements 11.8.2 Determine their centre of gravity 11.8.3 Ensure that everything is solid 11.8.4 Rig the elements 11.8.5 Install hauling cables 11.8.6 Cut or remove the bolts partially 11.8.7 Move the elements	The elements to be removed must be identified so that it is later possible, if applicable, to put them back in place. Once removed, the elements must be placed on the ground on blocking accessories.
11.9 Modify, repair, reinforce elements		This may involve, for example: – adding plates to reinforce a structure; – removing bridging, beams, etc., to add stairs; – opening a roof to add a glass roof; – reinforcing the structure to add to a floor; – changing conveyor walkways; – redo finishes (stairway railings, welding, grinding, primer or paint touch-ups); – etc.
11.10 Replace elements	11.10.1 Position the new elements 11.10.2 Install temporary guys, if applicable 11.10.3 Bolt or weld the elements 11.10.4 Do primer or paint touch-ups, if applicable 11.10.5 Reclose the openings 11.10.6 Remove safety devices from the elements	
11.11 Put removed elements back, if applicable		
11.12 Do the finishing		
11.13 Put the bridging back, if applicable		
11.14 Make sure of the quality of your work	11.14.1 Ensure that the work is completed and compliant 11.14.2 Have your work verified by your supervisor, if applicable	

TASK 11 MODIFY, REPAIR AND REINFORCE STRUCTURAL OR ARCHITECTURAL ELEMENTS

<i>Operations</i>	<i>Sub-Operations</i>	<i>Clarifications</i>
11.15 Store the tools and equipment	11.15.1 Sort the materials 11.15.2 Dispose of unrecyclable materials 11.15.3 Recover the useful materials 11.15.4 Clean the tools 11.15.5 Store the materials and tools at the appropriate locations 11.15.6 Report the loss or failure of tools or equipment	

TASK 12 DISMANTLE STRUCTURAL OR ARCHITECTURAL ELEMENTS

Dismantling applies mainly to structural elements (around 80% of cases). This task is complex and requires a lot of planning so as to control the removal of elements, keep the elements stable until removal, avoid accidents, etc.

<i>Operations</i>	<i>Sub-Operations</i>	<i>Clarifications</i>
12.1 Receive instructions		Instructions may pertain, for example, to the following aspects: health and safety hazards, work location, work description, etc. In addition, the ironworker may have to interpret plans (lifting, assembly, etc.).
12.2 Select the tools and equipment	12.2.1 Prepare a list of tools and equipment 12.2.2 Determine the necessary quantities 12.2.3 Choose the tools 12.2.4 Choose the rigging equipment 12.2.5 Choose the access equipment (scaffold, platform, etc.) 12.2.6 Gather the tools and equipment 12.2.7 Make sure the tools and equipment are in good condition	
12.3 Secure the work area	12.3.1 Establish traffic and access paths 12.3.2 Delimit the work area 12.3.3 Detect hazards and obstacles around the work area 12.3.4 Determine the lifting device's position	The safety perimeter may be established with cones, ropes, tape (yellow or red), etc. Dismantling work involves major hazards that must be taken into account and controlled.
12.4 Install the safety devices		These may be vertical or horizontal lifelines, railings, bracings, etc., depending on the nature of the work. It is also important to ensure that the devices are compliant, in good condition and solidly fastened.

TASK 12 DISMANTLE STRUCTURAL OR ARCHITECTURAL ELEMENTS		
Operations	Sub-Operations	Clarifications
12.5 Remove bridging, if applicable		During bridging removal, it is important to check the position of joists or bridging supports to ensure they are not damaged.
12.6 Stabilize the elements (with guys, if applicable)		To stabilize the elements, it may be necessary, for example, to install temporary guys or columns. The purpose of this operation is to ensure that the elements remain solidly in place and that none will fall during the work.
12.7 Install scaffolds, if applicable	See task 5.	
12.8 Identify the elements according to guidelines		The elements must be identified so that it is later possible, if applicable, to put them back in place.
12.9 Partially unbolt the elements or cut the rivets		This operation must be performed carefully while avoiding the removal of all bolts or rivets, which would cause the element to fall. In addition, it is essential to ensure that remaining bolts or rivets are solid enough to support the element.
12.10 Sling the elements	12.10.1 Choose slings that are appropriately long and large for the work 12.10.2 Check the slings' condition 12.10.3 Determine the elements' centre of gravity 12.10.4 Install the slings 12.10.5 Install hauling cables	
12.11 Unbolt, cut the rivets completely or gouge the welds		Before unbolting or cutting the rivets completely, the ironworker must verify with the lifting device operator that it has not reached (or is not about to reach) its load limit and can thus support the element's entire weight.
12.12 Receive the elements on the ground		Once removed, the elements must be placed on the ground on blocking accessories.

TASK 12 DISMANTLE STRUCTURAL OR ARCHITECTURAL ELEMENTS		
Operations	Sub-Operations	Clarifications
12.13 Load the elements on a carrier	12.13.1 Direct the carrier's positioning 12.13.2 Install blocking elements 12.13.3 Place the elements on blocking accessories	
12.14 Chain the elements	12.14.1 Make sure the elements are solid 12.14.2 See to it that each element is chained	
12.15 Make sure of the quality of your work	12.15.1 Ensure that the work is completed and compliant 12.15.2 Have your work verified by your supervisor, if applicable	
12.16 Store the tools and equipment	12.16.1 Dispose of unrecyclable materials 12.16.2 Recover the useful materials 12.16.3 Clean the tools 12.16.4 Store the materials and tools at the appropriate locations 12.16.5 Report the loss or failure of tools or equipment	

2.3 ACHIEVEMENT CONDITIONS

Data on achievement conditions were collected for the ironworker trade as a whole. The data pertain to aspects such as work areas, work instructions, health and safety hazards, reference works consulted, material resources used, etc.

Table 2.3 Achievement Conditions

ACHIEVEMENT CONDITIONS
<p>Work areas¹⁵</p> <p>The locations where ironworkers practice their trade depend on the type of work to be done. Building hardware work takes place most often indoors, whereas the erection of structural elements is most often done outdoors.</p> <p>Ironworkers who work outdoors are subject to difficult weather conditions, whereas indoors they often work in dusty and noisy environments.</p> <p>Ironworkers have to work from heights, enclosed spaces or restricted spaced.</p>

15. Non-exhaustive list.

ACHIEVEMENT CONDITIONS

Collaboration and supervision

Building hardware work is almost always done by a team of two ironworkers. Given that this type of work is generally of larger scale, the erection of architectural elements is mainly done by a team of several ironworkers, supervised by a foreman.

Whatever the type of work, ironworkers must be autonomous. However, it is pointed out that building hardware work, because it is generally done by a small team and without a foreman, requires that ironworkers be able to work unsupervised.

Instructions and references

Ironworkers receive verbal instructions from their foreman, as well as written instruction (installation plans, lifting plans, specifications, etc.). They refer to certain standards and specifications regarding, for example, the tightening torque to be observed.

Stress factors

The main stress factors are:

- health and safety hazards, for example during work from a height or near machinery in operation, or in case negligence by other workers or a contractor;
- the public's non-observance of safety perimeters;
- some difficult lifting tasks;
- some complex work;
- possible consequences of an error, for example in resistance calculations;
- conscientiousness and the importance of maintaining one's reputation as an ironworker;
- excessively tight deadlines;
- difficult weather conditions, for outdoor work;
- etc.

Raw materials, tools and equipment

Annex 1 contains a list of material resources used by ironworkers in practicing their trade.

Health and safety hazards

Annex 2 contains a detailed list of the main hazards involved in the tasks of the ironworker trade, as well as applicable preventive measures.

2.4 PERFORMANCE CRITERIA

Performance criteria were gathered for each task. They are used for assessing whether the tasks were performed satisfactorily. The criteria pertain to aspects such as the quantity and quality of work done, the observance of a safe work procedure, the attitudes to be adopted, etc.

To draw the list of criteria for each task, the participants worked in teams of two or three. Thus, certain criteria may at times be as relevant to other tasks than those for which they are mentioned.

Table 2.4 Performance Criteria

TASK 1	MOBILIZE A CONSTRUCTION SITE
Performance Criteria	
<ul style="list-style-type: none"> – Observance of health and safety rules – Respect for the environment – Following instructions – Meeting the standards in effect – Determining an appropriate safety perimeter – Sound assessment of the work to be done and its feasibility – Sound determination of the necessary tools, equipment and accessories for doing the work – Observance of the tools' capacity – Methodical work – Harmonious and efficient teamwork 	
TASK 2	ASSEMBLE THE LIFTING DEVICE
Performance Criteria	
<ul style="list-style-type: none"> – Observance of health and safety rules – Following instructions – Solid and balanced attachment of the load – Good preparation of the surface to receive the lifting device – Appropriate anchor of the lifting device – Observance of work methods and sequences – Effective communication with the lifting device's operator – Methodical work – Harmonious and efficient teamwork – Order and cleanliness of the premises during and after the work – Meeting timetables and deadlines 	

TASK 3 UNLOAD THE EQUIPMENT

Performance Criteria

- Observance of health and safety rules
- Following instructions
- Observance of the work sequence
- Sound choice of rigging accessories
- Observance of the lifting device's capacity
- Solid and balanced attachment of materials to be unloaded
- Methodical work
- Harmonious and efficient teamwork
- Correct classification of unloaded materials
- Effective communication with the lifting device's operator

TASK 4 RIG ELEMENTS

Performance Criteria

- Observance of health and safety rules
- Following instructions
- Correct estimate of the weight of loads to be moved
- Sound choice of rigging accessories
- Observance of the work sequence
- Observance of the lifting device's capacity
- Observance of anchor points
- Solid and balanced attachment of elements
- Methodical work
- Harmonious and efficient teamwork

TASK 5 INSTALL STATIONARY SCAFFOLDS

Performance Criteria

- Observance of health and safety rules
- Following instructions
- Appropriate levelling of the ground
- Careful verification of the terrain conditions
- Observance of the work sequence
- Appropriate anchoring of scaffolds
- Observance of the scaffold plan, if applicable
- Observance of the assembly sequence
- Methodical work
- Harmonious and efficient teamwork

TASK 6 **INSTALL STAIRWAYS AND WALKWAYS**
TASK 7 **INSTALL PROTECTIVE ELEMENTS**
TASK 8 **INSTALL COVERING ELEMENTS**

Performance Criteria

- Observance of health and safety rules
- Following instructions
- Correct interpretation of the various plans
- Exact positioning of elements
- Meeting standards and specifications
- Precise squaring
- Exact measurements
- Sound adaptation to the actual characteristics of the installation location
- Observance of the work sequence
- Methodical work
- Harmonious and efficient teamwork
- No damage to adjacent surfaces and to elements already installed

TASK 9 **ERECT STRUCTURAL ELEMENTS**

Performance Criteria

- Observance of health and safety rules
- Following instructions
- Correct interpretation of the various plans
- Appropriate use of tools and equipment
- Solid stabilization of assembled elements
- Precise measurements
- Adequately tightened bolts
- Observance of the tightening sequence
- Exact positioning of elements
- Meeting standards and specifications
- Precise squaring
- Sound adaptation to the actual characteristics of the installation location
- Observance of the work sequence
- Methodical work
- Harmonious and efficient teamwork
- No damage to adjacent surfaces and to elements already installed

TASK 10 ERECT PREFABRICATED ELEMENTS (CONCRETE, STEEL, MODULES, ETC.)

Performance Criteria

- Observance of health and safety rules
- Following instructions
- Correct interpretation of the various plans
- Appropriate use of tools and equipment
- Bolts tightened adequately
- Observance of the tightening sequence
- Exact positioning of elements
- Meeting standards and specifications
- Sound adaptation to the actual characteristics of the installation location
- Methodical work
- Harmonious and efficient teamwork
- Observance of the work sequence
- Solid stabilization of assemblies
- Observance of measurements
- Compliant installation of safety devices
- Observance of welding techniques
- Welding quality
- No damage to adjacent surfaces and to elements already installed

TASK 11 MODIFY, REPAIR AND REINFORCE STRUCTURAL OR ARCHITECTURAL ELEMENTS

Performance Criteria

- Observance of health and safety rules
- Following instructions
- Correct interpretation of the various plans
- Appropriate use of tools and equipment
- Bolts tightened adequately
- Observance of the tightening sequence
- Exact positioning of elements
- Meeting standards and specifications
- Sound adaptation to the actual characteristics of the installation location
- Methodical work
- Harmonious and efficient teamwork
- Observance of the work sequence
- Solid stabilization of assemblies
- Observance of measurements
- Compliant installation of safety devices
- Observance of welding techniques
- Welding quality
- No damage to adjacent surfaces and to elements already installed

TASK 12 DISMANTLE STRUCTURAL OR ARCHITECTURAL ELEMENTS

Performance Criteria

- Observance of health and safety rules
- Following instructions
- Correct interpretation of the various plans
- Carefully planning the work stages
- Appropriate use of tools and equipment
- Observance of plans
- Observance of the work sequence
- Compliant installation of safety devices
- Methodical work
- Harmonious and efficient teamwork
- No damage to adjacent surfaces and elements to be conserved

2.5 FUNCTIONS

Functions are a set of related tasks. That set may be defined by the work's results or by a sequence of steps.

For the ironworker trade, three functions appear to be involved:

- a function related to **work preparation** and grouping the following tasks:
 - mobilize a construction site;
 - assemble a lifting device;
 - unload the equipment;
 - rig elements;
 - install stationary scaffolds;

- a function related to **installation** and grouping the following tasks:
 - install stairways and walkways;
 - install protective elements;
 - install covering elements;
 - erect structural elements;
 - erect prefabricated elements (concrete, steel, modules, etc.);

- a function related to **modification**, **repair** and **dismantling**, and grouping the following tasks:
 - modify, repair and reinforce structural or architectural elements;
 - dismantle structural or architectural elements.

3. QUANTITATIVE DATA ON TASKS

3.1 OCCURRENCE

Occurrence data concern the percentage of ironworkers¹⁶ who perform each task. The data account not only for the time allocation of the workshop participants, but also for the latter's estimate of the time allocation of all the ironworkers who work in the companies represented.

Table 3.1 Task Occurrence

Task		Occurrence
1	Mobilize a construction site	46.5%
2	Assemble the lifting device	53.8%
3	Unload the equipment	73.5%
4	Rig elements	66.8%
5	Install stationary scaffolds	55.6%
6	Install stairways and walkways	57.2%
7	Install protective elements	66.1% ¹⁷
8	Install covering elements	
9	Erect structural elements	63.9%
10	Erect prefabricated elements (concrete, steel, modules, etc.)	52.0%
11	Modify, repair and reinforce structural or architectural elements	68.7%
12	Dismantle structural or architectural elements	57.5%

16. Including apprentices.

17. At the beginning of the workshop, a single task grouped tasks 7 et 8, i.e., "Install protective and cladding elements." That task was divided after the collection of quantitative data.

3.2 WORK TIME

Work time, also expressed in percentages, represents the average time allocated to each task by the participants, in the last 10 years.

Table 3.2 Work Time Allocated to Each Task

Task		Work Time
1	Mobilize a construction site	2.0%
2	Assemble the lifting device	3.5%
3	Unload the equipment	9.8%
4	Rig elements	7.9%
5	Install stationary scaffolds	4.5%
6	Install stairways and walkways	21.1%
7	Install protective elements	6.8%
8	Install covering elements	
9	Erect structural elements	22.3%
10	Erect prefabricated elements (concrete, steel, modules, etc.)	5.7%
11	Modify, repair and reinforce structural or architectural elements	12.2%
12	Dismantle structural or architectural elements	4.2%
		100.0%

Table 3.2 shows that the installation of stairways and walkways (task 6), as well as the erection of structural elements (task 9), each occupy more than 20% of ironworkers' work. Then come modification and repair work (task 11) at slightly more than 12%, and the unloading of materials (task 3) at almost 10%. The eight other tasks each represent less than 8% of hours worked.

Moreover, some of the participants never perform certain tasks:

- two persons never perform task 1;
- one person never performs tasks 2, 3 and 5;
- three persons never perform task 10.

3.3 IMPORTANCE AND DIFFICULT OF TASKS

The **importance** of a task is estimated according to the more or less harmful consequences of performing a task poorly or not at all. The importance is assessed according to the following scale:

1. Not important at all: A less successful execution of the task has no consequences on the quality of the result, the costs, health and safety, etc.;
2. Not very important: Poor execution of the task could lead to minimal costs, a result of lesser quality, minor injury or accident hazards, etc.;
3. Important: Poor execution of the task could lead to an unsatisfactory result, substantial additional costs, injuries, accidents, etc.;
4. Very important: Poor execution of the task could lead to an unacceptable result and have very major consequences in terms of costs, safety, etc.

A task's **difficulty** is assessed according to the following scale:

1. Very easy: The task involves little risk of error; it requires no notable physical or mental effort. Performing the task is less difficult than average;
2. Easy: The task involves a few risks of error; it requires minimal physical or mental effort;
3. Difficult: The task involves many risks of error; it requires a good physical or mental effort. Performing the task is more difficult than average;
4. Very difficult: The task involves a high risk of error; it requires substantial physical or mental effort. The task is among the most difficult in the trade.

Table 3.3 Importance and Difficulty of Tasks

	Task	Importance	Difficulty
1	Mobilize a construction site	1.9	1.4
2	Assemble the lifting device	3.6	2.2
3	Unload the equipment	3.2	2.3
4	Rig elements	3.5	2.2
5	Install stationary scaffolds	3.7	2.0
6	Install stairways and walkways	3.5	3.1
7	Install protective elements	3.5	2.5
8	Install covering elements		
9	Erect structural elements	3.6	2.9
10	Erect prefabricated elements (concrete, steel, modules, etc.)	3.7	2.9
11	Modify, repair and reinforce structural or architectural elements	3.6	3.0
12	Dismantle structural or architectural elements	4.0	3.4

4. KNOWLEDGE, SKILLS AND ATTITUDES

The occupational analysis enabled us to specify some of the knowledge, skills and attitudes necessary for performing the tasks. Those qualities are transferable, i.e., applicable to a variety of tasks and situations.

The following pages present the knowledge, skills and attitudes that, according to the participants, are considered essential for performing the tasks of the ironworker trade.

4.1 KNOWLEDGE

Communication and teamwork

Given that ironworkers work almost exclusively in teams, it is essential that they be able to establish and maintain good relations with their co-workers and supervisors, and with workers in other trades (e.g.: crane operators). In addition, they must know the terminology for the work to be done, the equipment used, etc., including the jargon of the trade and construction sites generally.

Machining

Although the elements are usually manufactured in-plant (and thus outside the construction site), ironworkers occasionally have to trace and cut elements with simple or even at times complex shapes, directly on the construction site. This is the case, for example, when necessary elements are unavailable or when delivery times are too long. Ironworkers then have to cope with the resources at hand and machine the elements they need to continue working.

Reading plans

Ironworkers have to read various types of plans: architectural, lifting, installation, dismantling, repair, reinforcement, etc. So they need basic plan-reading knowledge, particularly with symbols, scales and legends. At times they also must produce small freehand drawings, for example to explain a situation to their foreman.

Lifting

Ironworkers have to apply necessary rigging techniques for the various loads to be lifted and moved. They must choose lifting equipment according to the load and capacity of each device. To that effect, they must be able to calculate the weight of loads. Knowledge of a few concepts such as the leverage principle or an element's centre of gravity is also useful to ironworkers when planning how to move loads. Lastly, they must be able to operate certain lifting devices (e.g.: lift truck) or guide the operator of devices that have greater capacity. Knowledge of lifting signals is thus essential.

Mathematics

The application of mathematical knowledge is necessary to ironworkers – mainly the four basic operations, the rule of three and the basics of geometry (e.g.: Pythagorean theorem), to calculate, for example, material quantities, volumes, angles and weights, and to convert units from one measuring system to another. They must be able to perform those calculations with fractions and decimals. In addition, basic concepts of trigonometry (tangent, sine, cosine, etc.) are necessary when the ironworker has to assemble a stairway's elements.

Materials

Knowledge of the properties of materials used (particularly metals for welding work) is an asset for ironworkers. For example, they must distinguish between types of steel, choose filler metals for welding, etc. They must also have a good knowledge of all the hardware they commonly use, for example bolts (types, diameters, etc.).

Occupational health and safety

Ironworkers must know the occupational health and safety rules and standards of prevention. They must know numerous implications of the laws and regulations, for example standard 3.24.4 of the Safety Code for the construction industry, with respect to elevated rescues, or Act C-21 with respect to health and safety violations. In addition, ironworkers must, in certain cases, know the specific measures to apply on certain construction sites and in certain companies¹⁸. In such cases, ironworkers have to take training sessions specific to those construction sites or companies and to attend meetings on important measures to be applied.

¹⁸. In matters of health and safety, some companies' internal policies are more complex and restrictive than the usual practices required by the *Safety Code for the construction industry*.

Moreover, given that ironworkers use a variety of products, knowledge of the Workplace Hazardous Materials Information System (WHMIS) is very important, by teaching them about necessary precautions for using, transporting and storing those products. Lastly, ironworkers must also know and apply the rules for working in enclosed spaces and from heights.

Welding, oxy-fuel cutting, gouging and plasma cutting

All ironworkers must have basic welding knowledge. However, some “specialize” in that field; contractors mainly assign those workers to welding work. Those ironworkers must of course know the various processes, their characteristics and limitations, particularly shielded metal arc welding (SMAW), TIG and MIG and, more and more, flux cored arc welding, as well as related techniques. Ironworkers must also be able to interpret welding symbols on plans.

Moreover, knowledge of oxy-fuel cutting techniques is also necessary for adjusting dials meticulously, determining the cutting direction, etc., according to the characteristics of the metal to be cut. Ironworkers must also know gouging techniques, for example to remove welds when dismantling elements, as well as plasma cutting techniques used occasionally.

4.2 SKILLS

Skills are types of know-how. They are divided into three categories: cognitive, motor and perceptual.

Cognitive skills

Cognitive skills pertain to intellectual strategies applied in working. The main cognitive skills that ironworkers need are the following:

- problem-solving, for example when plan data do not correspond to actual data on-site;
- planning, for example to determine the steps to take when performing certain tasks;
- method, for example to follow work processes without missing steps;
- quickness of mind.

Motor skills

Motor skills involve gestures and movements. The main motor skills that ironworkers need are the following:

- dexterity;
- coordination of their movements with those of their co-worker(s);
- flexibility and agility, to perform tasks involving awkward positions;
- skill in working from heights;
- good reflexes.

Perceptual skills

Perceptual skills are sensory skills enabling a person to perceive by his senses what is happening in his environment. The main perceptual skills that ironworkers need are the following:

- perception of abnormal odours, for example from a gas leak;
- spatial perception, for example spatial orientation skill or the ability to imagine parts three-dimensionally;
- the ability to work “blind,” for example for some welding work done with a mirror;
- the ability to evaluate distances and depths, for example when moving loads;
- good peripheral vision.

4.3 ATTITUDES

Attitudes are ways of acting, reacting and relating with others or with one's environment. They involve personal skills. The main attitudes that ironworkers need are the following:

- patience;
- discipline;
- punctuality and diligence;
- interest in the work;
- teamwork ability;
- respect for one's co-workers, supervisors and workers in other trades;
- workmanship;
- preventive attitude regarding health and safety, and determination to follow the rules;
- vigilance.

5. TRAINING SUGGESTIONS

Initial training

The participants made suggestions about various aspects of the initial training:

- improve plan reading training;
- establish stages in the field so that students can witness the context of a construction site;
- favour the admission of students who are older, more mature and more interested in the training;
- increase the welding training hours.

Continuous training and professional development

Regarding professional development, the participants suggested the following:

- welding;
- plan reading;
- new products, tools or equipment;
- current standards for bolting, tightening, welding, etc.

Moreover, the participants suggested that more professional development activities be organized in the regions, more specifically outside large urban centres.

Annexes

RAW MATERIALS, TOOLS AND EQUIPMENT

Based on the lists of raw materials, tools and equipment in Red Seal's *National Occupational Analysis of the Ironworker (Structural/Ornamental) Trade*, the participants drew a list of the tools and equipment they use for each task.

Shaded boxes indicate items that are **not** used.

Table A.1 Tools and Equipment

	Mobilize a construction site	Assemble the lifting device	Unload the equipment	Rig elements	Install stationary scaffolds	Install stairways and walkways	Install protective elements	Install covering elements	Erect structural elements	Erect prefabricated elements (concrete, steel, modules, etc.)	Modify, repair and reinforce structural or architectural elements	Dismantle structural or architectural elements
HAND TOOLS												
reamers												
beam clamps												
aligning bar												
hickey bar												
finger clamp												
wire brush												
tool belt												
side/diagonal cutters												
tin snips												
cold chisel												
spud wrench												
knocker wrench												
pipe wrenches												
adjustable wrenches												
chalk line												
bolt cutters												
cable cutters												
knives												
hydraulic jack												
combination square												

	Mobilize a construction site	Assemble the lifting device	Unload the equipment	Rig elements	Install stationary scaffolds	Install stairways and walkways	Install protective elements	Install covering elements	Erect structural elements	Erect prefabricated elements (concrete, steel, modules, etc.)	Modify, repair and reinforce structural or architectural elements	Dismantle structural or architectural elements
drill bits												
pins (drift, bull)												
scrapers												
rod bag												
Allen key set												
combination wrench set												
socket set												
tap set												
flashlight												
prybar												
files												
chipping hammer												
hammers												
sledge hammer												
pliers												
needle nose pliers												
slip joint pliers												
cable cutters												
marlinspike												
punch												
centre punch												
tie wire reel												
bolt bag												
hack saw												
tool bucket												
bar clamps												
screwdrivers — Robertson; Philips, flat blades												
nut drivers												
SAFETY EQUIPMENT												
air movers (fans)												
cables												
perimeter cables												
stanchion posts												
ropes (fibre, wire)												
life lines												

	Mobilize a construction site	Assemble the lifting device	Unload the equipment	Rig elements	Install stationary scaffolds	Install stairways and walkways	Install protective elements	Install covering elements	Erect structural elements	Erect prefabricated elements (concrete, steel, modules, etc.)	Modify, repair and reinforce structural or architectural elements	Dismantle structural or architectural elements
fire blankets												
fume and toxic gas detector												
eye wash facilities												
portable lighting												
welding flash screens												
first aid equipment												
fire extinguishers												
guard rails												
anchor points												
warning tape												
signage												
PERSONAL PROTECTIVE EQUIPMENT												
respirators												
steel toe boots												
ear plugs												
hard hat												
safety belt												
coveralls (fire retardant)												
retractable lanyard												
rope grab												
fall arresters												
welding shield												
face shield												
gloves												
rubber gloves												
welding gloves												
insulated gloves												
knee pads												
safety vest												
welding jacket												
full body harness												
safety glasses												
welding helmet												
breathable air pack												
welding apron												
lock-out kit												

	Mobilize a construction site	Assemble the lifting device	Unload the equipment	Rig elements	Install stationary scaffolds	Install stairways and walkways	Install protective elements	Install covering elements	Erect structural elements	Erect prefabricated elements (concrete, steel, modules, etc.)	Modify, repair and reinforce structural or architectural elements	Dismantle structural or architectural elements
POWER TOOLS AND EQUIPMENT												
compressor												
disk												
powder actuated tool												
generator												
rivet buster												
grinder												
pencil grinder												
peening tool												
impact drill												
power drill												
mag drill												
impact gun												
tension control gun												
gas deck saw												
circular saw												
band saw												
chop saw												
gas cut-off saw												
reciprocating saw												
electric hacksaw												
porta band												
hydraulic jacks (and accessories)												
MEASURING AND LAYOUT EQUIPMENT												
string line												
chalk line												
distometer												
scale												
squares (combination, framing)												
laser square												
bevel square												
piano wire												
plumb line												
rod level												
spirit level												
laser level												

	Mobilize a construction site	Assemble the lifting device	Unload the equipment	Rig elements	Install stationary scaffolds	Install stairways and walkways	Install protective elements	Install covering elements	Erect structural elements	Erect prefabricated elements (concrete, steel, modules, etc.)	Modify, repair and reinforce structural or architectural elements	Dismantle structural or architectural elements
builders level												
optical level												
torpedo level												
straight edges												
measuring tape												
theodolite												
transit												
tripod												
SPECIALTY TOOLS AND EQUIPMENT (WELDING AND CUTTING TOOLS)												
arc-air (gouger)												
arc welding machine												
thermite welding machine												
MIG welder												
submerged arc machine												
stud welding gun												
chipping hammer												
cutting tools (oxygen, acetylene, propane)												
plasma cutter												
SCAFFOLD AND ACCESS EQUIPMENT												
gas powered articulated boom lift												
electrical articulated boom lift												
end frames												
sawhorses												
stationary scaffolds												
mechanical scaffolds												
rolling scaffolds												
swing stages												
extension ladder												
ladders												
stepladders												
boom lifts												
aluminium planks												
aerial work platforms												
aluminium framed platforms												
electrical vertical lift												
ramps												

	Mobilize a construction site	Assemble the lifting device	Unload the equipment	Rig elements	Install stationary scaffolds	Install stairways and walkways	Install protective elements	Install covering elements	Erect structural elements	Erect prefabricated elements (concrete, steel, modules, etc.)	Modify, repair and reinforce structural or architectural elements	Dismantle structural or architectural elements
floats (angel's wings)												
scissor lift												
gas powered scissor lift												
electrical scissor lift												
tubes and clamps												
temporary access/freight elevator												
RIGGING EQUIPMENT												
softeners												
rings and lines												
beam clamps												
eye bolts												
wire rope												
fibre rope												
chain												
bridle hitch												
thimbles												
hooks												
wedge socket												
dunnage												
spreaders												
wire rope slings												
multiple-leg bridle slings												
synthetic slings												
swivels												
shackles												
blocks												
chain falls												
tackle blocks												
come-alongs												
equalizer beam												
spreader beam												
rope clips												
simple roller												
multi-bearing rollers												
sheaves												
cable clamps												

	Mobilize a construction site	Assemble the lifting device	Unload the equipment	Rig elements	Install stationary scaffolds	Install stairways and walkways	Install protective elements	Install covering elements	Erect structural elements	Erect prefabricated elements (concrete, steel, modules, etc.)	Modify, repair and reinforce structural or architectural elements	Dismantle structural or architectural elements
turnbuckles												
binders												
winches												
mechanical/hydraulic jacks												
HANDLING EQUIPMENT												
cradle												
boom trucks												
rollers												
forklifts (telescopic, electric, gas powered)												
stretcher												
chain falls												
come-alongs												
multi-bearing rollers												
pallet jack												
tugger												

MATRIX OF OCCUPATIONAL HEALTH AND SAFETY HAZARDS

Produced by: **Johanne Paquette, Eng.**, Prevention-Inspection Consultant

Commission de la santé et de la sécurité du travail

Table A.2 Occupational Health and Safety Hazards in the Ironworker Trade

No.	Hazards	Effects on Health and Safety	Means of Prevention
1	<p>Chemical hazards or dangers</p> <ul style="list-style-type: none"> ➤ Gases and welding fumes ➤ Dust ➤ Chemicals (cleaners, oils, solvents, spray paint) ➤ Presence of gases during work in enclosed spaces 	<ul style="list-style-type: none"> • Asthma, chronic bronchitis, lung cancer • Eye and respiratory tract irritation • Coughing, headache • Headache • Respiratory disorders • Intoxication 	<ul style="list-style-type: none"> • Keeping the head away from the plume. • Not breathing fumes and gases. • Using exhaust ventilation systems. • Wearing appropriate eye and respiratory protectors. • Not drinking or eating where welding fumes may be emitted. • Wearing appropriate eye and respiratory protectors. • Having on the premises the material safety data sheets of products used. • Choosing less toxic products of equal effectiveness. • Informing and training workers about the hazards of using the products. • Using a four-gas emission tester. • Wearing appropriate respiratory protection. • Ensuring that the enclosed space is ventilated.

No.	Hazards	Effects on Health and Safety	Means of Prevention
2	<p>Physical hazards or dangers</p> <ul style="list-style-type: none"> ➤ Noise from heavy machinery, other machines, tools ➤ Vibrations transmitted to upper limbs by vibrating pneumatic machines or tools ➤ Presence of live electric lines ➤ Electrical hazards related to live materials and workpieces ➤ Temperature stress: exposure to cold and heat, humidity 	<ul style="list-style-type: none"> • Occupational deafness • Hearing loss • Hand-arm vibration syndrome • Electric discharge or burn • Electrification • Electrocutation (death) • Electrification • Electrocutation • Heatstroke • Dehydration 	<ul style="list-style-type: none"> • Wearing hearing protectors (earmuffs, plugs). • Using tools that vibrate less. • Using only tools that are well maintained and in good operating condition. • Holding the vibrating tool as lightly as possible to ensure safety, and allowing the tool to do the work. • To the extent possible, resting the vibrating tool on a support or on the workpiece. • Storing tools so as to keep their handle warm for the next use. • Planning tasks and breaks so as to reduce exposure to vibrations. • Staying at the minimum approach distances prescribed by the Safety Code for the construction industry. • Agreeing with the power company about safety measures to take. • Grounding machines and workpieces. • Making sure electric devices are in good condition. • Adjusting the pace of work to weather conditions while taking into account workers' capacities and adaptation to heat. • Wearing light and light-coloured clothing that allows sweat to evaporate. • Covering the head to work outdoors. • Drinking enough cold water.

No.	Hazards	Effects on Health and Safety	Means of Prevention
	<ul style="list-style-type: none"> <li data-bbox="261 827 467 856">➤ Flying sparks <li data-bbox="261 989 509 1079">➤ Ultraviolet and infrared radiation (welding flash) <li data-bbox="261 1188 553 1218">➤ Handling metal parts <li data-bbox="261 1570 483 1600">➤ Fire, explosion 	<ul style="list-style-type: none"> <li data-bbox="605 306 927 336">• Chilblains, hypothermia <li data-bbox="605 831 971 951">• Skin burns through contact with a hot workpiece, sparks or projections of molten metal <li data-bbox="605 993 943 1022">• Radiation burns, keratitis <li data-bbox="605 1188 708 1218">• Cuts <li data-bbox="605 1289 748 1318">• Tetanus <li data-bbox="605 1575 724 1604">• Burns <li data-bbox="605 1612 724 1642">• Death 	<ul style="list-style-type: none"> <li data-bbox="1003 306 1325 336">• Wearing warm clothing. <li data-bbox="1003 344 1325 373">• Having heated shelters. <li data-bbox="1003 382 1430 438">• Covering tools' metal handles and bars with thermal insulation. <li data-bbox="1003 447 1430 596">• Wearing clothing – several layers if necessary – according to the weather and the nature of tasks to perform, and covering the head. <li data-bbox="1003 604 1403 661">• Alternating work and warm-up periods. <li data-bbox="1003 669 1422 789">• Reorganizing the work so that outdoor tasks are performed during the warmest times of the day. <li data-bbox="1003 831 1406 917">• Wearing protective clothing resistant to heat, sparks and projections of molten particles. <li data-bbox="1003 926 1360 955">• Wearing protective gloves. <li data-bbox="1003 993 1386 1047">• Wearing an appropriate face shield. <li data-bbox="1003 1056 1252 1085">• Installing shields. <li data-bbox="1003 1094 1382 1150">• Wearing appropriate filtering lenses. <li data-bbox="1003 1188 1360 1218">• Wearing protective gloves. <li data-bbox="1003 1226 1422 1255">• Keeping vaccination up-to-date. <li data-bbox="1003 1289 1406 1375">• Carefully cleaning any wound, even small, with running water and mild soap. <li data-bbox="1003 1383 1430 1533">• Consulting a doctor if the wound is very dirty or deep; the risk of contracting tetanus is greater if vaccination was administered more than five years previously. <li data-bbox="1003 1575 1365 1661">• Using explosion-proof equipment and spark-proof tools. <li data-bbox="1003 1669 1377 1755">• Planning to have firefighting equipment nearby (e.g.: fire extinguishers).

No.	Hazards	Effects on Health and Safety	Means of Prevention
3	<p>Biological hazards or dangers</p> <ul style="list-style-type: none"> ➤ Infectious materials, bacteriological contaminants during work in contaminated environments ➤ Toxic plants during brush clearing ➤ Presence of insects ➤ Presence of bees and wasps 	<ul style="list-style-type: none"> • Tetanus • Skin irritations • Lyme disease and West Nile virus • Serious allergic reactions 	<ul style="list-style-type: none"> • Keeping vaccination up-to-date. • Carefully cleaning any wound, even small, with running water and mild soap. • Consulting a doctor if the wound is very dirty or deep; the risk of contracting tetanus is greater if vaccination was administered more than five years previously. • Wearing gloves, boots, raincoats, coveralls, glasses, visors, masks. • Cleaning tools and materials after working in a contaminated environment. • Wearing work gloves. • Covering the skin. • Protecting oneself against insects and ticks by applying DEET-based (maximum 30%) insect repellent on uncovered skin. • Covering the skin as much as possible (long sleeves and slacks) and preferably wearing light-coloured clothing. • Wearing short or tied-back hair. • Avoiding the use of perfumed products. • Never approaching a wasp nest. • Informing one's supervisor so that he will have the nest destroyed by experts, if necessary. • Never drinking directly from a can or bottle. A bee or wasp may be there and sting the worker in the throat, which could be fatal. • Having effective means of communication.

No.	Hazards	Effects on Health and Safety	Means of Prevention
	<ul style="list-style-type: none"> ➤ UV exposure 	<ul style="list-style-type: none"> • Skin cancer • Sunburns 	<ul style="list-style-type: none"> • Covering the skin. • Using sunscreen.
4	<p>Ergonomic hazards or dangers</p> <ul style="list-style-type: none"> ➤ Handling and moving heavy loads and parts ➤ Making repetitive movements ➤ Standing for a long time ➤ Awkward postures ➤ Walking in difficult, uneven terrain 	<ul style="list-style-type: none"> • Backache • Tendinitis, bursitis • Foot pain • Muscular fatigue • Backache 	<ul style="list-style-type: none"> • Using lifting and handling equipment. • Knowing safe handling techniques. • Rotating tasks. • Wearing gear in good condition, correctly adjusted. • Adjusting the height of tools and equipment to the worker's height. • Changing position frequently.
5	<p>Miscellaneous safety hazards or dangers</p> <ul style="list-style-type: none"> ➤ Fall when working from a height ➤ Same-level fall during work in uneven terrain or irregular surfaces 	<ul style="list-style-type: none"> • Death • Multiple injuries • Fractures, sprains, strains 	<ul style="list-style-type: none"> • Assemble elements on the ground if possible. • Put in place a protective system against falls from heights (collective and individual protection). • Developing and testing a procedure for rescuing a worker suspended from a harness after falling during the assembly or disassembly of a metal frame. • Making a reconnaissance of the work area to detect holes and obstacles. • Levelling the ground. • Picking up debris on the construction site. • Wearing appropriate safety footwear.

No.	Hazards	Effects on Health and Safety	Means of Prevention
	<ul style="list-style-type: none"> ➤ Use of power tools (chain-saw, impact drill, etc.) ➤ Superimposed work ➤ Fall of objects or materials from a higher level ➤ Fall of heavy objects on the feet ➤ Lightning when work takes place outdoors during a storm 	<ul style="list-style-type: none"> • Projections of foreign bodies in the eyes • Injuries to lower and upper limbs • Death • Injuries • Contusion, being crushed, amputation • Electric discharge • Electrocutation 	<ul style="list-style-type: none"> • Wearing an appropriate protective visor. • Training workers in the use of tools. • Wearing a hard hat. • Delimiting the work areas and controlling their access. • Not allowing work to be done simultaneously in superimposed areas, unless lower areas are protected from falling equipment, materials or objects. • Installing devices to stabilize elements of the structure under construction or demolition. • Wearing safety boots equipped with puncture-resistant soles and Class 1 toe caps. • Using handling equipment. • Never staying under an isolated tree, along a deforested glade, in a clearing or at the top of a hill. • Staying away from any vertical structure such as a post, mast, crane or another metal structure. • Staying away from anything that conducts electricity, such as metal fences. • As soon as a storm is approaching, finding a safe shelter such as a vehicle or building; otherwise, taking shelter in a cave, in a crevasse or under a cliff. • When in a forest, taking shelter under dense vegetation of bushes or small trees.

No.	Hazards	Effects on Health and Safety	Means of Prevention
	<p>➤ Aggression by wild animals during work in remote areas (black bears)</p>	<ul style="list-style-type: none"> • Bites, scratches, lacerations 	<ul style="list-style-type: none"> • If lightning strikes before there is time to take shelter, crouching with forehead on knees, while making sure that the hands and clothing do not touch the ground. • Not laying on the ground, because that would increase contact with charges conducted by moist soil. • Taking precautions even if the storm is not yet above oneself, because lightning can strike several kilometres from the cloud of origin. • If 30 seconds or less pass between lightning and thunder, shelter must be found. It is recommended to stay there for 30 minutes after the last thunder. • If less than 5 seconds pass between lightning and thunder, it is necessary to take shelter immediately. <ul style="list-style-type: none"> • Keeping the black bear at a respectful distance. • Never feeding it. • Storing food and garbage beyond its reach. • Eliminating food and garbage odours by keeping food and garbage in hermetic containers. <p>Behaviour to adopt in the event of such an encounter:</p> <ul style="list-style-type: none"> • Remaining calm and assessing the situation. • Not screaming or making sudden moves. Talking gently to the bear. Waving one's arms so that it recognizes that a human is present. • Slowly backing up toward safe shelter or making a detour to move around the animal. If that is impossible, allowing it a path to take flight. Giving it enough space to turn back.

No.	Hazards	Effects on Health and Safety	Means of Prevention
	<ul style="list-style-type: none"> ➤ Isolated work ➤ Work in trenches or excavations ➤ Work in enclosed spaces in the presence of explosive gases 	<ul style="list-style-type: none"> • No rescue in the event of a serious accident • Asphyxia • Being crushed • Being buried • Fire • Explosion 	<ul style="list-style-type: none"> • If the bear approaches, not running away, unless a safe place can be reached quickly. Running away can incite the bear to follow the person as its prey. • Avoiding eye contact with the bear, because it might perceive that as a threat. • Continuing to back up slowly to detect a safe place, while keeping an eye on it. • Waving one's arms or throwing objects to distract it. • Not playing dead with the black bear. Rather, staying attentive to the situation and being ready to face it in case of attack. • If the bear attacks, defending oneself with everything at hand rocks, stick, oar, axe, etc. Impressing it by raising one's voice, yelling and waving one's arms. • Establishing a regular monitoring procedure. • Having effective means of communication. • Ensuring that the walls are shored up or pose no risk of sliding. • Measuring the concentrations and then entering the enclosed space with a gas detector. • Ventilating the enclosed space to eliminate the gases.

No.	Hazards	Effects on Health and Safety	Means of Prevention
6	<p>Psychosocial hazards or dangers</p> <ul style="list-style-type: none"> ➤ Psychological harassment ➤ Time constraints 	<ul style="list-style-type: none"> • Depression, burn-out • Stress • Backache • Insomnia 	<ul style="list-style-type: none"> • Specifying each worker's roles and tasks to reduce role-related ambiguity and conflicts. • Clarifying each worker's roles, responsibilities and powers in order to reduce risks of role-related conflicts. • Setting precise goals and objectives in order to reduce risks of confusion and ambiguity. • Defining the various expectations clearly. • Planning all stages of the work. • Limiting work done under pressure.

Annex 3
COMMENTS AND APPROVAL OF THE
IRONWORKER VOCATIONAL SUBCOMMITTEE

At the meeting held in Montreal on January 20, 2015, the ironworker vocational subcommittee unanimously approved the occupational analysis report modified according to the following comments:

1. Page 3, Point *1.1 Definition of the Trade*, third paragraph:
 - Add, following the Regulation defining the ironworker trade, the following sentence:
“Ironworkers perform all the work mentioned in that definition”;
the change has been made.
 - Remove the mention “heavy laminated wood”;
the sentence containing that mention has been removed.
2. Page 13, Point *1.10 Development of the Trade*, third point:
 - Replace “reinforced polymer” with “FRP – fibre reinforced polymer”;
the change has been made.
3. Page 17, *Operation 6.7 Position the stringers and C-channels*:
 - replace “Position the stringers and C-channels” with “Position the stringers”;
the change has been made.
4. Page 17, *Operations 6.9 Install the steps and risers and 6.10 Do the final squaring and make level*:
 - invert the order of those operations;
a footnote has been added to specify that the order of those operations is inverted in some cases.

5. Page 18, *Task 9 Erect structural elements*:

- add an operation, between operations 9.1 and 9.2, that would read as follows: “Read the plans or drawings and the specifications”;
an operation “9.2 Read the plans or drawings” has been added;
- add an operation, between operations 9.9 and 9.10, that would read as follows: “9.10 Install guys”;
an operation “9.11 Install temporary guys” has been added.

6. Page 18, *Task 10 Erect prefabricated elements (concrete, steel, modules, etc.)*:

- add an operation regarding the installation of guys;
a verification demonstrated that the installation of guys is not required for erecting prefabricated elements. But it has been deemed useful to add, to operation “10.7 Position and stabilize the element,” brackets specifying the use of “hand winches.”

7. Page 19. *Task 12 Dismantle structural or architectural elements*:

- add an operation regarding the installation of guys;
brackets have been added to operation “12.6 Stabilize the elements” to specify “with guys, if applicable »;
- to operation 12.11, add the removal of welds by oxy-fuel cutting, gouging or another process;
after verification, only gouging is used for removing welds. Operation 12.11 has thus been changed as follows: “Unbolt, cut the rivets completely or gouge the welds.”

8. Page 25, *Task 5 Install stationary scaffolds*:

- add an operation 5.10 as follows: “Ensure the installation’s conformity before climbing to work on it”;
given that the suggested text does not correspond to an operation, a footnote has been added to make that point.

9. Page 26, *Operation 6.7 Position the stringers and C-channels*:

- replace “Position the stringers and C-channels” with “Position the stringers”;
- the change has been made.

10. Page 33, *Operation 9.9 Assemble the structure*:

- add a sub-operation 9.9.5 as follows: “Install spacers essential to the joists’ stability and load-bearing capacity”;

this operation became 9.10 after the addition of operation “9.2 Read the plans or drawings.” The following sub-operation has been added: “9.10.5 Install spacers, if applicable.”

11. Page 43, Point 2.4 *Performance Criteria*, first paragraph, third line:

- replace “... work procedure...” with “... safe work procedure...”;

the change has been made.

12. Page 53, Point 4.1 *Knowledge, Machining*, third line:

- replace “... elements with simple shapes directly on the construction site...” with “... elements with simple or at times very complex shapes directly on the construction site...”;

given that the level of complexity is difficult to evaluate, the text has been modified as follows: “... elements with simple or even at times complex shapes, directly on the construction site...”

13. Page 54, footnote 18:

- replace the footnote “In matters of health and safety, some companies’ internal policies go beyond legal requirements” with the following footnote: “In matters of health and safety, some companies’ internal policies are more complex and restrictive than the usual practices required by the *Safety Code for the construction industry*;

the change has been made.

14. Page 55, *Welding and oxy-fuel cutting*:

- replace the subtitle “Welding and oxy-fuel cutting” with “Welding, oxy-fuel cutting, gouging and plasma cutting”;

the change has been made.

15. Page 57, Point 4.3 *Attitudes*:

- replace the title “Attitudes” with “Attitudes and Aptitudes”;

a verification demonstrated that this section refers only to attitudes;

- add the following attitudes: good reflexes, vigilance and quickness of mind;
“good reflexes” has been added in section 4.2 below “Motor skills” and “quickness of mind” has been added in section 4.2 below “Cognitive skills.”

16. Page 59, *Point 5. Training Suggestions, Continuous training and professional development:*

- Add the following aspect of professional development: “Understanding and application of current standards such as: bolting, tightening, welding, etc.”;
the aspect of professional development “current standards for bolting, tightening, welding, etc.” has been added.