Training the Next Generation of Tower Technicians

The Structure, Tower and Antenna Council (STAC) helps ensure communications towers in Canada continue to be constructed with the highest regard to worker safety.

STAC is a non-profit Council of the Canadian Wireless Telecommunications Association (CWTA), representing and providing a collaborative forum for Canadian wireless communications carriers, tower owners/operators, tower and rooftop equipment engineering service suppliers, and wireless communication facilities construction and maintenance contractors.

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Executive Summary

The demand for wireless services continues to accelerate in Canada – new applications and the ever-growing appetite for wireless connectivity is driving vast expansions of the nation's networks. Over the years, and particularly over the course of the pandemic, wireless communications networks have been critical in stimulating Canada's growing economy, and technological advancements such as 5G have been deemed critical in helping to achieve the country's climate commitments. Undoubtedly, the telecommunications tower industry is set to continue expanding at an exponential rate, now and well into the future.

Nearly 40 years since the first Canadian wireless towers were erected, we believe the time has come to establish standardized training for new telecommunications tower technicians. This offers an opportunity for post-secondary educational institutions and specialized training providers to support Canada's ever-growing need for wireless connectivity by helping to train the next generation of this highly demanded workforce and to contribute to an industry that will continue to play a significant role in fueling economic growth and innovation in Canada.

Through lengthy deliberations, research, and interviews with individuals involved in the launch of similar training programs in the U.S.A., committee members have prepared this document to guide the development of accredited training programs in different regions of the country. Importantly, this work has identified six primary areas of study for those training to become tower technicians, as well as corresponding subtopics per each subject. The six areas of study are:

- An Introduction to Telecommunications;
- Climbing and Safety;
- Measurements;
- Construction;
- Rigging; and
- Electrical and Radiofrequencies (RF) Safety.

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Should there be any questions about this document, including further information on the process that went into its development, explanations on individual topics under each module and/or clarification of any words or terms, please feel free to contact info@stacouncil.ca.

We hope you will join us in embarking on this important and timely initiative – one that supports Canada's transitioning economy, and ensures Canadians continue benefiting from world-leading wireless networks and technology for the years to come.

1. Background & About STAC

The telecommunications industry continues to grow as the number of Canadians and devices connecting to wireless networks increases every year. As wireless technology becomes more and more ubiquitous – and as 5G, the next generation of wireless technology, rolls out – the increase in demand for connectivity will only continue to go up. For this reason, there is an immediate and growing need for an expansion of telecommunications tower contractors in order to keep up with maintenance and reinforcement of the networks and infrastructure Canadians are increasingly relying on.

As a result of this continued growth and the significance of wireless connectivity to modern Canadian society, wireless providers have committed billions of dollars over the past years to upgrade and expand their mobile networks. These are necessary and critical investments, but points to the tremendous labour challenges the industry continues to face. The gap between the demand for those who build and maintain wireless network infrastructure, and the supply of those with the specialized skills to do so, is growing.

In addition to this, circumstances like the COVID-19 pandemic underline the imperative need for continued investment in the expansion of wireless network coverage, to ensure all Canadians have access to our nation's world-leading wireless technologies to stay connected. Investment in 5G is also crucial to maintaining Canada's competitiveness – if widely deployed across Canada, 5G will enable a new wave of innovation, with the potential to create an estimated 250,000 new jobs by 2026 and contribute an additional $40 billion in GDP over the same period. This will require an estimated investment of $26 billion by facilities-based service providers.

To sustain the increase in demand, wireless tower contracting companies will need to consistently recruit and train new tower technicians in the years ahead. With a lack of standardized industry training requirements, employers are hiring and training new technicians themselves, and, as a result, creating significant disparities in not only the types of training, but quality of training provided to new employees entering the industry. And, as with any specialized workforce, the lack of adequate and standardized training can potentially result in mistakes that lead to hazardous working conditions.

The structure, tower and antenna industry faces unprecedented recruitment challenges regarding the medium- and long-term supply of workers, critical to meeting this growing demand for wireless services. As there are not enough new workers joining the workforce to fill these labour shortages, industry stakeholders are identifying ways to address these skills shortages and what courses of action can be taken. While a multi-pronged approach is necessary, the purpose of this document is to specifically focus on one of the major factors identified for addressing skills shortages: the development of a standardized training program.

Harmonized training and skill requirements for new-hires in the industry would help ensure critical Canadian communications infrastructure continues to be constructed with the highest regard for worker safety and network quality. In addition, a robust training program would provide students with an opportunity to work in a formal training environment to obtain the necessary skills needed as a telecommunications tower technician, and would help ensure they are work-ready upon graduation.

The Structure, Tower & Antenna Council (STAC) is a non-profit Council of the Canadian Wireless Telecommunications Association (CWTA), representing and providing a collaborative forum for Canadian wireless communications carriers, tower owners/operators, tower and rooftop equipment engineering service suppliers, and wireless communication facilities construction and maintenance contractors. STAC's mission is to help ensure communications structures in Canada continue to be constructed with the highest regard for worker safety.

As the only such group dedicated to Canadian communications towers safety, STAC has prepared this document to provide an overview of the themes and subject matter that could form the basis of a comprehensive training program for new telecommunications tower technicians.

This document was developed with the support and counsel of the STAC Industry Workforce Committee and its volunteer members representing a range of employers in the telecommunications sector. The Committee's mandate is to work with employers, workers, training and academic institutions, professional associations, and government to identify skills shortages and barriers to entry (both perceived and real). The Committee seeks to develop tools and resources for employers, new and prospective workers, and academia to ensure there is sector alignment on developing a skilled and employment-ready workforce. Through labour force research, the Committee will identify specific skills shortages across Canada, educate and inform prospective workers about the opportunities of a career in the tower industry and develop resources for employers to attract and hire workers.

The purpose of this document is to support the STAC Industry Workforce Committee's recommendation of harmonized training and skill requirements for workers, as well as provide more information to institutions and training providers that are looking to establish programs for the next generation of tower technicians.

Of note, the information contained in this document exclusively reflects the recommendations and opinions of volunteer industry participants of the STAC Industry Workforce Committee. Neither STAC nor its parent body, the Canadian Wireless Telecommunications Association (CWTA), nor any contributing Members, make any representations, warranties or conditions regarding the accuracy, timeliness, completeness, sufficiency, or suitability of the information in this document for any particular purpose.

2. Objective

STAC is eager to assist educational institutions and training providers that are seeking to offer this important and timely curriculum to the next generation of tower technicians that will build and maintain our national wireless infrastructure. In addition, STAC members are eager to provide on-the-job placement programs for students, and full-time employment to those who successfully complete their training, making this an appealing and valuable opportunity for anyone that may be considering a career in this field.

As the need for trained workers in this specialized area reaches a critical point in meeting growing wireless services demand, this document identifies the key components that the STAC Industry Workforce Committee would like to see included in a standardized training program for new telecommunications tower technicians. It includes information pertaining to the scope of work as well as proposed learning outcomes, learning modules and course subjects that Committee members deem valuable for beginner-level training courses. The ultimate hope is that this document supports the development of a nationwide standardized tower technician program for the next generation of workers to better ensure safety on the field, and to create a labour force that is work-ready upon completion.

3. Application

Prospective training providers are encouraged to use this document to gain a better sense of the general training outcomes telecommunications infrastructure companies are seeking in new-hire technicians prior to entering the workforce. Industry members from the STAC Industry Workforce Committee who have helped craft this document believe students equipped with the training recommendations reflected in this document will have the skillset to perform the work of a telecommunications tower technician safely and to an adequate level of quality, under appropriate supervision, as well as further benefit from longer-term career opportunities and a trajectory in the telecommunications industry.

The recommendations in this document are intended to serve as a resource when developing a comprehensive telecommunications tower technician training program. **Section 4** of this document outlines the current scope of work of a tower technician – as developed by STAC Industry Workforce Committee members – and can provide prospective training providers with a more holistic understanding of the work they perform and specific certifications needed in accordance with industry safety best practices. **Section 5** of this document provides a brief description of the six general areas of learning that Committee members recommend for new tower technicians and identifies how knowledge of these subjects will benefit students in their careers. **Section 6** provides information about Committee members' perspectives on enhanced training through workplace learning placements. Lastly, the appendixes contain detailed lists of recommended topics under each of the six modules, to further expand on the information provided in these areas.

4. Scope of Work

4.1 Definition

A telecommunications tower technician is any worker whose primary job functions relate to the building/installation, servicing, maintenance and/or decommissioning/demolition of communications towers and/or rooftop communications sites. Tower technicians play a vital role in the provisioning of infrastructure to enable and support communications networks, including mobile telephony, wireless internet service and broadcast communications.

4.2 Responsibilities

A tower technician's primary responsibilities include:

- Applying best practices for safe work-at-heights and complying with all safety standards, regulations and legislation;
- Installing, repairing and/or decommissioning telecommunications infrastructure, antennas and associated auxiliary equipment, including while working at heights;
- Safe use of winches, hoists and other lifting equipment;
- Identifying potential hazards on telecommunications towers and other sites;
- Following detailed instructions as identified by scope of work and method of procedures (MOP) documentation;
- Completing fibre termination and splicing; and
- Completing work to customer specifications and in accordance with all operational requirements.

4.3 Qualification and Skills Requirements

The qualifications and typical skills required of a telecommunications tower technician include:

- The ability to work safely at heights;
- Working knowledge of applicable safety standards and regulations;
- Working knowledge of rigging and craning principles;
- Working knowledge of the operation and safety requirements of hand tools and power tools;
- The ability to work in a physically demanding environment that requires stamina for most job tasks;
- The ability to travel for several weeks at a time;
- Completion of high school education or equivalent;
- A basic understanding of telecommunications systems (asset);
- A basic understanding of telecommunications testing equipment (asset);
- Experience with RF, fibre optic and DC power cable installation, antennas and radios (asset);
- Post-secondary education in a related or otherwise relevant field (asset); and
- The ability to read and interpret engineering diagrams and drawings (asset).

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4.4 Certification Requirements

The primary certifications required of new telecommunications tower technicians typically include:

- Working at heights/fall protection training;
- Ladder safety training;
- High-angle/tower rescue training;
- RF safety awareness;
- Confined space awareness;
- Wilderness and/or remote work training;
- Safe hoisting and rigging training;
- First Aid/CPR;
- WHMIS;
- A valid driver's licence;
- Electrical safety and awareness training; and
- Other provincial certifications, as required.

5. Desired Course Material Overview

Members of the STAC Industry Workforce Committee have identified six broad subject matters to serve as the desired foundation of knowledge for new-hire telecommunications tower technicians. These subject matters form the basis of the six learning modules used to organize the suggested course content: Introduction to Telecommunications, Climbing and Safety, Measurements, Construction, Rigging, and Electrical & Radiofrequencies (RF) Safety.

This section provides an overview of each module, including a description of the identified topics and discusses their application in the tower industry. Desired learning outcomes and proposed topics for each outcome are contained in the appendixes. Members of the STAC Industry Workforce Committee believe students would require a minimum of four weeks of classroom and lab instruction – not including on-the-job placements – to effectively learn the suggested course content and receive the recommended certifications. Similarly, Committee members believe learning outcomes can be best demonstrated through written and practical examinations administered by the training providers and qualified certification providers.

5.1 Introduction to Telecommunications

The Introduction to Telecommunications module is designed to provide students with a high-level understanding of Canadian telecommunications systems and cabling, the telecommunications infrastructure industry and the nature of the work completed by telecommunications tower technicians. This module also includes topics designed to provide students with an introductory knowledge of antenna-supporting structures and the types of hazards that are typically found on telecommunications sites.

The topics in this first module will support students' ability to understand the wireless networks and related infrastructure that telecommunications tower technicians build and maintain, allowing them to better appreciate the interrelated nature of the subjects covered in the following modules. This will provide valuable insights that ultimately support on-the-job knowledge, growth and retention by providing them with a baseline knowledge of telecommunications infrastructure and telecommunications tower industry. Information covered in this module will also discuss the importance of being consistently vigilant on the job with regards to industry safety protocols and best practices that are vital to completing a tower technician's work safely.

5.2 Climbing and Safety

The Climbing and Safety module is designed to provide students with introductory fall protection safety and rescue training outlined in the STAC Climber Training Guidelines, a best practices document developed over three years by experienced fall protection safety trainers and tower industry personnel. In this module, students will learn about the proper use, fit and care of the working at heights personal protective equipment (PPE) typically used by telecommunications tower technicians, and will be taught the appropriate methods for safely ascending and descending communications towers in accordance with industry best practices. Students will also learn about the nature of tower rescues and will be taught to perform self-rescue techniques that follow industry best practices.

The information contained in the Climbing and Safety module is pivotal to a tower technician's ability to safely perform work-at-heights, which is a significant portion of the job. In addition to helping improve students' safety outcomes as they progress through their training and begin working in the field, the information in this module will help to improve the safety outcomes of all other personnel on site.

STAC Climber Training Guidelines v1.0
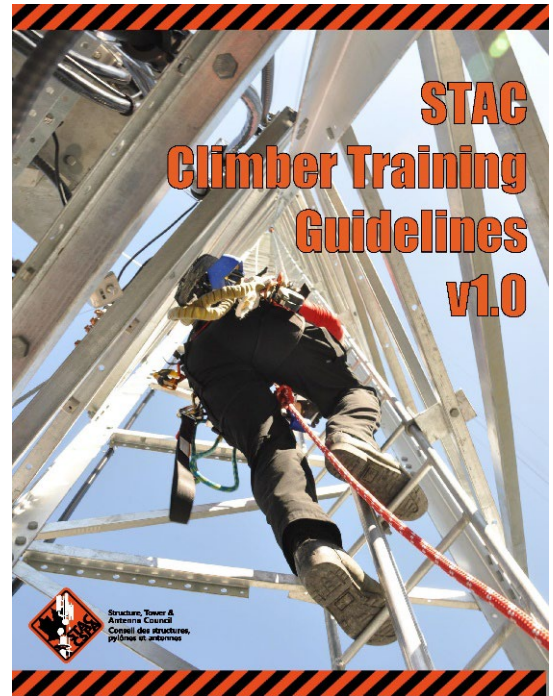
5.3 Measurements

Topics included in the Measurements module are designed to provide students with knowledge on test measurements of various equipment and devices commonly used in the industry, including radiofrequency (RF), power, and fiber optical equipment. It also includes information on the structural measurements that are used when performing tower technician tasks.

Telecommunications tower technicians will apply the knowledge contained in this module on a regular basis, in order to verify that their work has been completed to an acceptable standard in accordance with industry best practices and client requirements. Quality assurance is a core function of the role, and is essential to ensuring consistency of the telecommunications networks Canadians rely on. Lastly, information contained in this module will inform students on how to perform work safely when sources of energy and other emissions are present.

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5.4 Construction

The Construction module is designed to build on the introductory knowledge of antenna-supporting structures found in the Introduction to Telecommunications module, teaching students about the types of structures tower technicians build and maintain, and the process for doing so. Students will also learn in this module about the proper use of various tools and equipment needed on the job in accordance with industry best practices, as well as all applicable standards, regulations, and manufacturer instructions.

Just as with the Measurements module, telecommunications tower technicians will regularly apply the knowledge contained in this module to verify that the work they perform has been completed to an acceptable standard of quality in accordance with industry best practices and client requirements. Construction quality assurance similarly serves as a core function of a technician's job, and is essential to ensuring consistency of the telecommunications networks and longevity of infrastructure that supports those networks. Information contained in this module will also help to ensure students perform work safely when working on or around antenna-supporting structures that are in various construction phases.
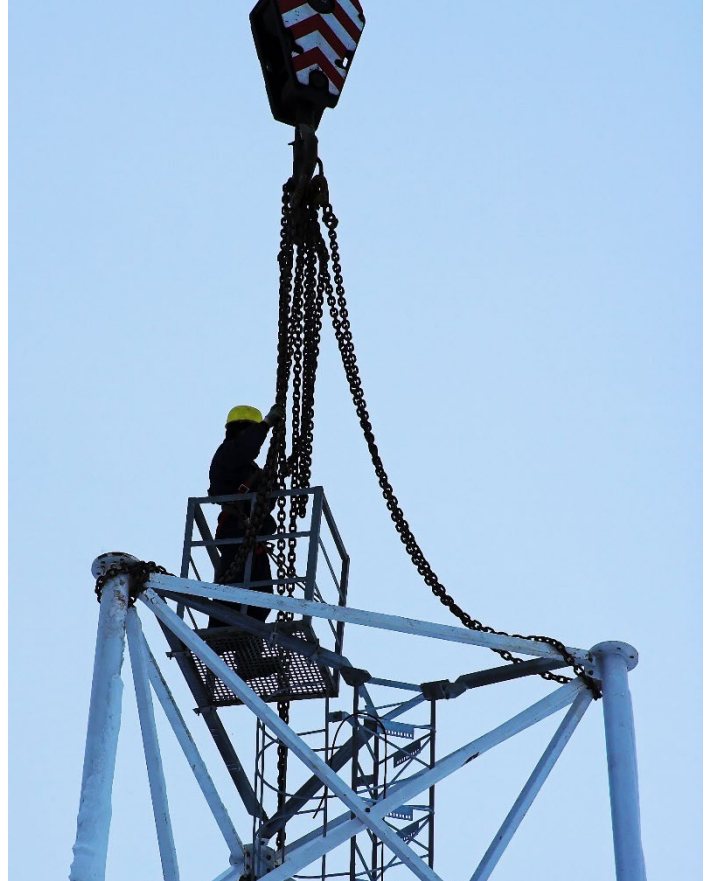
5.5 Rigging

In this module, students will learn best practices for rigging telecommunications towers, providing a critical foundation of knowledge and experience in doing so safely with different types of equipment. This module includes topics focused on the fundamental mechanics of rigging and lifting, including an overview of commonly used knots that support rigging applications in the industry, the use of cranes, crane signals and capstan operations.

Adequate knowledge of rigging practices and principles is considered a core requirement for safely performing tasks, as working tower technicians will regularly apply the knowledge contained in this module when constructing and modifying telecommunications towers. This module builds on the principles and learnings provided in the Construction module, similarly focused on ensuring work is completed safely and to a high level of quality. Rigging quality assurance is also a basic requirement of a technician's job, and is essential to ensuring consistency of the telecommunications networks and longevity of infrastructure supporting them.

5.6 Electrical and Radiofrequencies (RF) Safety

Materials included in the Electrical and Radiofrequencies (RF) Safety module will teach students how to safely install and handle electrical and RF-emitting equipment and devices. This includes topics on the safe handling and installation of such equipment, designed to teach students what types of activities can – and cannot – be performed while using them, and other related limitations.

The information and learnings included in this module represent yet another core responsibility of a telecommunications tower technician, due to the frequent handling and installation of such equipment. This section will help guide safe installment of this equipment, and reiterates the importance of doing so in helping to maintain the quality and consistency of Canadian telecommunications networks.

5.7 Certifications

In addition to the six general learning modules identified in this section, members of the STAC Industry Workforce Committee believe students who complete a comprehensive tower telecommunications technician program would benefit from obtaining the following certifications as part of their baseline training:

- Working at heights/fall protection*;
- High-angle/tower rescue*; and
- Safety Code 6 RF Awareness.

May be combined

6. Workplace Learning Placement

Following completion of the six classroom and lab-based learning modules, STAC Industry Workforce Committee members believe additional structured learning through the completion of workplace learning placement(s) would be exceptionally beneficial to students entering the workforce. This will allow for significant experience-based learning through tasks that are completed on-site, and provides students the opportunity to further develop hands-on knowledge of the job, reinforcing the theory-based learning they will have obtained from class and lab-based sessions by applying this knowledge in the field.

An ideal learning placement would provide students with the opportunity to gain exposure to different types of activities and tasks that tower technicians complete, including, but not limited to, tower erection, tower maintenance and rooftop and antenna installations. However, it must be recognized that the types of activities students will be exposed to during a workplace learning placement will be limited to those included in the partnering employer's scope of work, and understandable that not all students will gain similar activity exposures during their placements.

Ultimately, members of the STAC Industry Workforce Committee believe learning placements provide students with an important opportunity to solidify the practical knowledge gained from the modules, allowing for hands-on learning experience that will better prepare them for work in the field. The goal is to ensure students are prepared to start a full-time career in the industry upon completion of their workplace placement.

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Appendix 1: Detailed Notes - Introduction to Telecommunications

Suggested Learning Outcomes

- Gain necessary knowledge and adequate preparation of the Canadian telecommunications tower industry;
- Gain basic knowledge of telecommunications networks and operations, including history and implementation;
- Learn about the different career paths that can be taken within the telecommunications tower industry;
- Gain knowledge on the telecommunications tower industry including standards and regulations; and
- Learn various telecommunications tower industry terms and definitions.

Suggested Course Content

- Cellular networks
- Carrier collocation and vertical real estate industry
- Components of tower compounds
- Tower types
- Structural member designations
- Tower bracing types
- Introduction to job site hazards
- General tower maintenance issues
- Guyed tower structural components
- Guyed tower maintenance issues
- Coax types
- Fibre
- Ethernet
- Antenna types
- AM Towers
- Introduction to the CSA S37 standard
- Basic construction drawings
- Verification of drawings through measurements/inspection
- Site preparation
- Heavy equipment planning
- Traffic control
- Working around protected species
- Introduction to the ANSI/ASSP A10.48 standard
- Project documentation requirements

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Appendix 2: Detailed Notes – Climbing and Safety

Suggested Learning Outcomes

- Learn about industry regulations regarding working at heights;
- Become proficient and comfortable with correct usage of fall protection PPE: inspection, fit, limitations, hazard mitigation, manufacturer approved configurations and uses of equipment;
- Gain knowledge of tower self-rescue techniques and rescue equipment;
- Learn safe and efficient work at heights utilizing work positioning systems and tool tethering techniques; and
- Become proficient in job-site hazard identification on telecommunications tower sites, including those relating to working at heights, drop-zone and environmental hazards.

Suggested Course Content

- *STAC Climber Training Guidelines* – Climber 1
  - Introduction
  - Introduction to Legislation, Standards and Company Policy(s)
  - Observation of Performance
  - Anchorages
  - Anchorage Connectors
  - Snap Hooks and Carabiners
  - Full Body Harnesses
  - Energy Absorbing Lanyards
  - Work Positioning Lanyards
  - Self-Retracting Devices (SRDs)
  - Vertical Lifelines and Rope Grabs
  - Permanent Vertical Fall Arrest Systems
  - Horizontal Lifelines
  - Knots
  - Pre-Climb Checklists and Hazard Assessments
  - Climbing Techniques
  - Working on Rooftops
  - Inspection, Care and Maintenance
  - Examination & Practical Evaluation

- *STAC Climber Training Guidelines* – Rescue 1
  - Introduction
  - Introduction to Legislation, Standards and Company Policy(s)
  - Observation of Performance
  - Rescue Planning
  - Mitigating Suspension Trauma
  - Introduction to Rescue Devices
  - Self-Rescue
  - Controlled Descent
  - Inspection, Care and Maintenance
  - Examination & Practical Evaluation

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Appendix 3: Detailed Notes – Measurements

<u>Suggested Learning Outcomes</u>
- Learn how to identify job site hazards related to RF and demonstrate acceptable use of a personal RF monitoring devices (PPE);
- Learn the correct usage of calipers, measuring tape, diameter tape, and digital UT gauge;
- Gain the ability to accurately measure guy wire tensions with instrumentation;
- Learn how to accurately measure a wide variety of steel shapes and document per industry best practices;
- Learn how to assess guyed tower plumb and twist with transit;
- Learn how to identify azimuths and nature of down-tilt, and their impact on antenna operations; and
- Understand the concepts and measurements required for cables, antenna, fibre and Ethernet.

<u>Suggested Course Content</u>
- RF awareness training
- Calipers, measuring tape, diameter tape
- Angles, guy wires, solid round, channel, plates
- Bolts
- Drawing and recording tower sections
- Pipes and hollow structural sections
- Plumb and twist of a guyed tower
- Plumbness of monopoles and self-support towers
- Tension
- Plumb and twist of a guyed tower (practice)
- Plumbness of monopoles and self-support towers (practice)
- Tension (practice)

Appendix 4: Detailed Notes – Construction

<u>Suggested Learning Outcomes</u>
- Learn how to read and interpret construction drawings;
- Gain basic knowledge of tower erection and modification processes;
- Gain basic knowledge on the types of antenna-supporting structures utilized in the wireless telecommunications industry, and the processes for erecting those structures;
- Learn introductory information about tower foundations;
- Learn safe usage of common power tools (drill, mag-drill, bandsaw, grinder, RF connection tools, crimpers, etc.) and hand tools; and
- Become proficient with bolt installation and torque procedures.

<u>Suggested Course Content</u>
- Tower foundations overview - types and safety
- Guy wire preforms
- Installation and relaying preform demonstration
- Power tool safety and usage (drill, mag drill safety, grinder, bandsaw)
- Wrench usage
- Torquing bolts
- Turn-of-nut method vs. verified torque
- Hands-on practice
- Reading construction drawings
- Bolt minimum edge, coping, gauge line
- Measure, cut, and assemble simple mount from drawings

Appendix 5: Detailed Notes – Rigging

Suggested Learning Outcomes

- Learn how to read and interpret construction drawings;
- Gain knowledge on safe usage and selection of rigging implements; and
- Gain knowledge on the safe operation of rigging equipment.

Suggested Course Content

- Rigging environmental factors
- Introduction to manual vs. mechanical rigging
- Tower rigging types
- Introduction to gin poles
- Introduction to capstan operator training
- Knots (clove, figure 8, figure 8 on a bight, bowline)
- Slings (ratings, hitch types)
- Shackles
- Blocks (types, attachments, etc.)
- Rigging blocks to tower using slings
- Tying knots for load and tag system (supervised)
- Signal to capstan operator (instructor) to hoist load
- Bolting mount pipe to tower
- Signalperson practical exam
- Crane safety and signals
- Mount installation practice (rigging, hoisting, bolting)

Appendix 6: Detailed Notes – Electrical and RF Safety

Suggested Learning Outcomes

- Learn about grounding principles, installation and proper functioning of grounding systems;
- Gain knowledge of telecom site AC and DC electrical systems and batteries, including safe installation;
- Gain knowledge of antenna, coax and fiber connections, weatherproofing, and support; and
- Gain basic knowledge of electrical safety pertinent to telecommunications tower sites, including proficiency in identifying electrical hazards on telecommunications tower sites.

Suggested Course Content

- General electrical safety and theory
- Electrical hazards on telecom sites
- Cable accessories and standards
- Cable handling and support
- Cable labelling configurations for carriers
- Tracking/tracing a line
- Grounding systems
- Telco battery systems and installation
- Cable types, including ground cables
- Indoor/outdoor cabling, including weatherproofing
- AC/DC systems
- Cable crimping and dressing
- Cable grounding
- RF cable types (including indoor vs. outdoor, LDF4, etc.)
- RF cable dressing and support systems
- Introduction to RF cable terminations
- Working with fiber cable and connectors
- Hoisting and attaching coax
- Supporting/weatherproofing/grounding coax per drawings
- Return-loss measurements (line sweeping)
- RF safety working around high-powered antennas