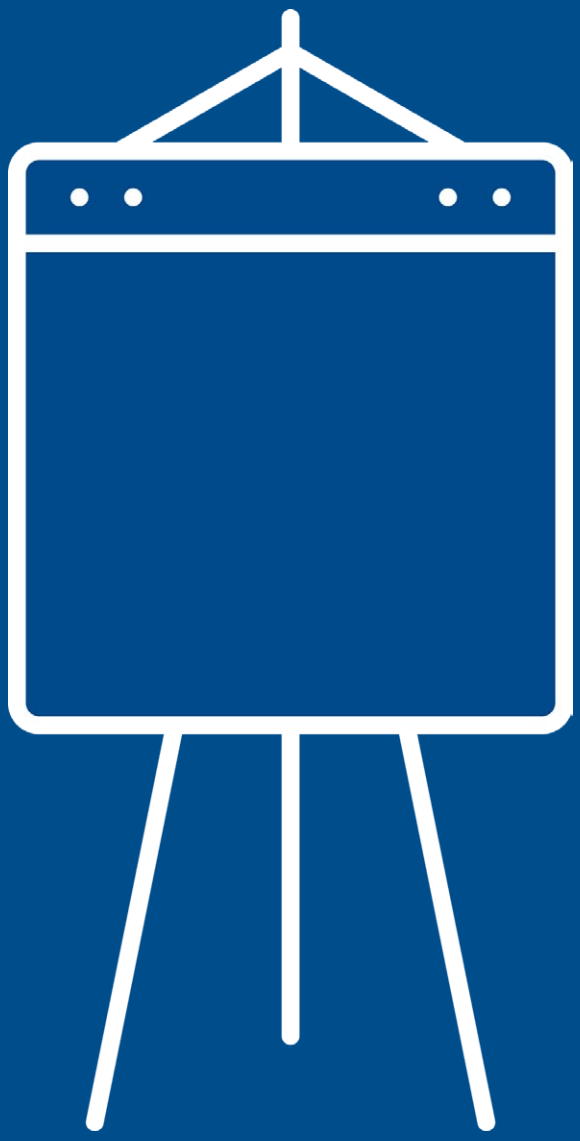
Essential Skills and OHS Training



A guide to embedding an essential skills curriculum within an OHS training program

Institute for Work & Health
Research Excellence Advancing Employee Health

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Essential Skills and OHS Training: A guide to embedding an essential skills curriculum within an OHS training program

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Preface

This guide has been developed through a research project titled "Addressing essential skills gaps among participants in an occupational health and safety training program: a pilot study." The project was funded by the Max Bell Foundation and the Research Opportunities Program of the Ontario Ministry of Labour. The project was a collaboration among the Institute for Work & Health (IWH), Blueprint ADE, Labourers' International Union of North America (LIUNA) Local 506 Training Centre, Infrastructure Health & Safety Association (IHSA), Social Research and Demonstration Corporation, SkillPlan, and experts in the design of essential skills curriculum.

The project sought to determine whether the outcomes of an occupational health and safety (OHS) training program could be improved by modifying it to address gaps in essential skills (ES). In a prior feasibility study, we identified the hoisting and rigging program offered by LIUNA Local 506 (using curriculum developed by IHSA) as the best candidate for a pilot study. This occupation is high risk, and most of the trainee population has ES gaps.

Through consultations with the training centre and a review of the existing curriculum, we identified document use and numeracy as the essential skills most important in the hoisting and rigging program. We worked with ES curriculum experts, the training centre and IHSA to develop a modified curriculum designed to improve those aspects of numeracy and document use that are related to the job of hoisting and rigging. Changes included: new text on how to use Ontario's *Occupational Health and Safety Act* and regulations as a reference document, new explanatory content for different types of calculations, and updated calculation examples that included substeps.

We assigned some trainee groups to the regular curriculum and others to the modified one, and assessed learning outcomes for each, mainly through written tests. At the beginning of each training intake, we assessed the document use and numeracy skill levels of trainees. We also collected information about age, first language, languages spoken at home, educational attainment, experience in the industry, and experience in the hoisting and rigging occupation, and used these as control variables in the analysis.

Scores on the written test taken after the training were significantly higher among those who took the modified program (i.e. with the embedded ES curriculum) than among those who did not.[1]

> *Scores on the written test taken **after the training** were significantly higher among those who took the modified program…*

We conducted interviews and focus groups with trainees to ascertain their views about the training program and the applicability of the training to their work. We interviewed key staff of the training centre, including the instructor who delivered most sessions of the pilot program, and those involved in the curriculum development process about their experience in the development/delivery of the pilot program. We met with the four sector-based health and safety associations (HSAs) in Ontario to discuss preliminary findings and seek their advice on what would be most useful in a guide. Trainees, training centre staff and the HSAs all emphasized the importance of connecting the training to what is expected by employers and supervisors at worksites. Trainees also emphasized the importance of hands-on training using the equipment that they would use on the job.

1 *Because of the small sample size, control variables were entered alternately in the analysis.*

About this guide

What is the purpose of this guide?

This step-by-step guide is designed to give OHS training organizations an overview of the process involved in modifying the curriculum of an existing OHS training program in order to address gaps in essential skills among their trainee populations.

Who should use this guide?

OHS organizations that deliver training programs to groups with relatively low levels of essential skills will find this guide instructive. The guide is applicable across a range of industries and training organizations. The process it outlines can be applied and adapted for use by organizations of different sizes. The guide may be helpful to instructional designers, subject-matter experts and instructors involved in the design and delivery of OHS training programs.

How to use this guide

This guide outlines a 12-step process for embedding an ES curriculum into an existing OHS training program. Practical "tips" are noted on ways to facilitate the process, as well as suggestions for "going beyond"—additional steps that may be considered, depending on available resources. In addition, an appendix provides examples of before-and-after curriculum from the pilot study, as well as sample qualitative evaluation questions. This guide may be used by an individual or a team as an overview and guide to what should be considered before and during efforts to revise and update an OHS training program to incorporate an ES curriculum.

What are "essential skills"?

Through extensive research, the Government of Canada and other international agencies have identified and validated nine dimensions of essential skills: reading, document use, numeracy, writing, oral communication, working with others, continuous learning, thinking, and computer use (*see page 8*). These skills "are the foundation for learning all other skills and help people evolve with their jobs and adapt to workplace change."

[Employment and Social Development Canada (ESDC) website: https://www.canada.ca/en/employment-social-development/programs/essential-skills.html]

What are “essential skills gaps”?

ESDC has developed a system to rate the “complexity” of the essential skills required by workers in different occupations. The rating system uses a five-point scale, from Level 1 (basic) to Level 5 (advanced), as shown in the example below.

For example, the level of difficulty of reading tasks ranges between being able to read short texts to find a single piece of information (complexity Level 1), to being able to understand and use long and complicated texts, like contracts or reports (complexity Level 5). The ability to read at a complexity Level 3 is essential for most jobs, even for those that do not require a college diploma, university degree or specialized training.

Indeed, for most occupations, at least some of the tasks involved require essential skills at a Level 3 complexity rating or better to perform well. When workers do not possess the essential skills at the complexity rating required to do their job, the gap between their level and the job requirement is referred to as an “essential skills gap.”

Why address essential skills gaps?

Results from the 2012 Survey of Adult Skills under the Programme for the International Assessment of Adult Competencies showed that almost half of the working-age population in Canada scored below Level 3 in literacy, and over half scored below Level 3 in numeracy (Statistics Canada, 2013). This indicates that, for many workers, gaps exist between their ES levels and the requirements of their job. Gaps in essential skills such as oral communications, document interpretation and basic numeracy may impede the effectiveness of OHS training.

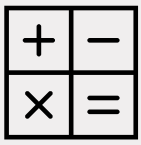
The 9 essential skills

Reading text

Reading refers to the skills needed to understand and apply information found in sentences and paragraphs.

Document use

Document use refers to the skills needed to find, enter and use letters, numbers, symbols and images in electronic and paper formats.



Numeracy

Numeracy refers to the skills needed to make sense of and apply mathematical concepts and information.

Writing

Writing refers to the skills needed to compose handwritten or typed text to communicate information and ideas.

Oral communication

Oral communication refers to the skills needed to exchange thoughts and information with other people.

Working with others

Working with others refers to the skills needed to interact with other people (one or more).

Continuous learning

Continuous learning refers to the skills needed to continually develop and improve one's skills and knowledge in order to work effectively and adapt to changes.

Thinking skills

Thinking refers to the skills needed to solve problems, make decisions, think critically, plan, remember details, and find information.

Digital technology

Digital technology refers to the skills needed to understand and use digital systems, tools and applications, and to process digital information.

The process at a glance

1. Identify a suitable OHS training program
2. Establish the project team
3. Outline data requirements
4. Identify relevant essential skills gaps
5. Develop ES curriculum to be embedded
6. Validate modified curriculum
7. Finalize curriculum documents
8. Train-the-trainer
9. Develop evaluation strategy
10. Test and fine-tune modified program
11. Implement final program
12. Evaluate the program

1 Identify a training program in which to embed essential skills curriculum

Review your training programs to determine which ones have a large proportion of trainees who are expected to have gaps in essential skills relative to the requirements of the job. These are likely the most suitable for embedding ES curriculum.

Talk to program instructors about candidate training programs because they tend to be familiar with the typical skill levels of trainees. Also consider the level of education required by occupations targeted by training programs. Occupations that do not require a post-secondary credential are more likely to have workers with gaps in essential skills.

Quick Tips

- Determine which essential skills are key to performing the job tasks targeted by a training program, as well as the complexity level associated with each of the essential skills required to do the job.
- Consider any gaps in the foundational skills trainees may have that prevent them from being 'ready to learn' the training content.
- Keep essential skills assessments under one hour to reduce frustration and fatigue among trainees doing the assessments. (In our pilot study, we tested for document use and numeracy skills. Some trainees took two hours to complete the test, which was frustrating to them.)

Going Beyond

Once a candidate program is identified, it is a good idea, if resources permit, to conduct a test of the key essential skills of one or more groups of trainees under the current program. This test can be done online (for a fee) through providers of workplace ES assessments (e.g. Essential Skills Group, Bow Valley College).

2 Establish a project team

Establish a project team to bring together the experts needed to embed ES curriculum into an existing OHS training program. This requires people with expertise in the development of ES curriculum and people with knowledge about the development and maintenance of the OHS curriculum in the current training program.

For example, the project team might include:

- a project coordinator,
- instructional designers,
- training professionals,
- trainers/instructors, and
- essential skills experts.

Ensure the curriculum development team consults with the instructors of the program. It will be important to have the instructors' commitment to the initiative and to draw on their expertise in meeting trainees' learning needs.

Identify at the outset of the project who will train the instructors on the delivery of the modified curriculum.

Going Beyond

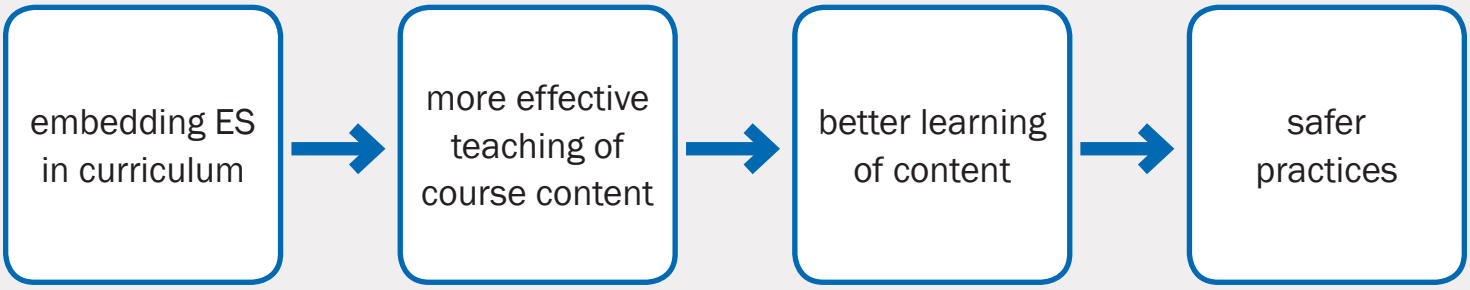
If formal evaluation of the program is to be undertaken (which is advisable if resources permit), expertise in program evaluation and data analysis will also be required. Someone with this expertise should also be invited to join the project team.

3 Outline data requirements

Identify the data that you plan to collect from participants, particularly data that will be useful in evaluating the program.

While details of the evaluation strategy can be fleshed out later—*see Step 9 on page 17*—develop an outline of the evaluation plan and related data requirements early in the process. This may involve a logic model that maps what the training is expected to accomplish and the pathways to final outcomes. For example, it would be useful to think of demographic characteristics of trainees that would be useful to collect, and/or to plan to interview instructors about their experiences with the modified curriculum.

Sample logic model:*



**Please note that this is a simplified version. In practice, one would identify the pathways in more detail.*

4 Identify the most important essential skills gaps to address

Often several essential skills are involved in a single task. For example, the work involved in rigging a load to be lifted by a crane on a construction site may require these essential skills: reading (of labels on equipment), document use (to refer to regulations), numeracy (to calculate if a load is safe to lift), thinking/problem-solving, oral communication, and working with others. However, it would be too much to address all these essential skills in a modified training program.

In order to keep the curriculum streamlined, identify which essential skills are most critical to safely doing the job(s) targeted by the training program, and focus the curriculum changes on these skills. Key considerations include:

- the areas in which trainees are known or expected to have ES gaps,
- the nature of the occupation (as noted above, ESDC has developed essential skills profiles for a wide range of occupations), and
- the practical needs of the job(s) that trainees do, such as the skills that they will be able to apply on the job, and how gaps in essential skills will affect workers' abilities to perform job tasks.

Quick Tip

Before redesigning a curriculum, consult the program instructors on the feasibility of the changes being considered.

5 Develop the essential skills curriculum to be embedded within the existing OHS training program

Identifying critical essential skills may require consultations with representatives of employers and workers, as well as with program instructors.

Review the existing curriculum and identify sections where the critical essential skills (identified in the previous step) are most salient and where ES supports—new curriculum designed to facilitate learning by those with gaps in essential skills—could be embedded.

Identify constraints on curriculum duration (i.e. regulatory requirements, client interest in streamlined training that focuses on practical application).

Observe delivery of the existing program and interview instructional staff on perceived essential skills needs for their trainees. Ask instructors about existing resources, ideas, relevant workplace documents or other supports that may have already been developed to address ES gaps.

Develop the content, drawing on external expertise in ES curriculum development if necessary. Include the following steps in the development of the content:

- contextualize the essential skills content to the tasks required by the job, and provide scenarios in which the key essential skills would be applied,
- build gradual steps to convey key concepts; i.e. “scaffold” answers to problems by providing all steps leading to the final answer,
- provide key words, tips, sample solutions and templates for exercises, and
- build in hands-on demonstrations, applications or other work-related tasks to help trainees practice the skills they learn in theory.

Quick Tip

For this project, we obtained assistance from SkillPlan (https://www.skillplan.ca/) because of its expertise on occupation-specific essential skills requirements.

6 Validate the modified curriculum with the instructional staff and other stakeholders, as required

Ask instructors of the current program to review a draft of the modified curriculum. Ask them to suggest ways to improve clarity and/or enhance the exercises designed to translate the concepts into examples/scenarios that would be used on the job.

If applicable, also consult industry stakeholders familiar with the current program.

7 Finalize the curriculum documents

Revise the curriculum in light of the input from instructors and stakeholders, and prepare the final curriculum documents. These may include, for example, course materials for students, an instructor's workbook and slides for instructors.

In our pilot project, changes to the curriculum included: new text on how to use Ontario's *Occupational Health and Safety Act* and regulations as a reference document, new explanatory content for different types of calculations, and updated calculation examples that included substeps. Examples of these changes (before and after) are included in this guide *(see Appendix A)*.

8 Offer a train-the-trainer session to help guide instructors on the delivery of the modified curriculum

Review with the instructors all of the final changes/additions to the curriculum (in both the student and instructor course materials). Use this as an opportunity for any further fine-tuning of the delivery plan based on feedback/suggestions from the instructors.

Quick Tip

When possible, try to schedule opportunities for instructors to practice delivering the new content close to the date of the actual training.

Review the rationale for the changes with the instructors. For example, explain which essential skills were the focus of the changes, and how and why they were identified as important.

Ensure instructors are aware that it is important that they reinforce with trainees the value of applying essential skills to be able to work safely.

9 Develop the evaluation strategy

Consider various evaluation methods for assessing the success (or not) of the program. Even if a formal evaluation of the program with the embedded essential skills curriculum is not possible due to resource constraints, some kind of evaluation strategy is needed.

Evaluation of the initiative could include assessing whether or not the changes to the curriculum improve learning outcomes, as well as whether they improve the safety of observed work practices on the job.

Quick Tip

It is helpful for the assessment to have a comparison group in order to be able to compare outcomes of trainees taking the modified program with the outcomes of those taking the regular program.

If your evaluation includes a comparison group, it's a good idea to collect information about trainee characteristics that may affect outcomes beyond the inclusion of ES training. This is helpful because randomly assigning trainees to take either the modified or regular training program will rarely be feasible (and randomization is one way to ensure that it is the program you are evaluating that is making the difference and not something else). In our pilot, for example, trainees had already signed up for the training courses, not knowing that some training groups would be given the regular program and others the modified one. By collecting information on trainee characteristics, you can "control" for these characteristics when comparing outcomes between trainees who received the modified program and trainees who received the regular program.

Quick Tip

In our pilot project, we collected data at the first session of each training intake on age, first language, languages spoken at home, educational attainment, experience in the industry, and experience in the hoisting and rigging occupation. These variables were used as "controls" in the analysis of the outcome data. We also used the score on the essential skills test as a control variable.*

**It is important to keep trainee data confidential and to de-identify the data prior to data analysis. This was done in our pilot project, although it was deemed by the University of Toronto Research Ethics Board to be exempt from research ethics review on the grounds that it "constitutes program evaluation, quality assurance (QA) or quality improvement (QI)."*

A key outcome variable would be the trainees' scores on tests of their learning taken after the training. Depending on the availability of equipment, such tests could include both a written test of knowledge and observation of trainees performing tasks using equipment that they would use at the workplace. You would then perform a statistical analysis of whether the scores are higher for those who took the modified program, while controlling for other variables (as explained above).

If resources do not permit a formal evaluation using a comparison group, plan to interview instructors with experience in delivering the standard curriculum about their experiences with the modified curriculum, as a way of getting a sense of whether the curriculum changes were helpful. (This is recommended also as a supplement to quantitative data analysis if you conduct a formal evaluation.)

Going Beyond

If resources permit and it is logistically feasible, it may be useful to conduct interviews with trainees and instructional staff to better understand their experiences and the effectiveness of the training. You may want to conduct worksite observations of trainees after they complete the training program to assess the extent to which workplace practices integrate what was taught in the classroom. It may also be useful to follow up with a sample of training graduates to learn about their experiences applying what they learned on the job. Appendix B provides a starting point for worksite observation considerations, and also includes sample interview questions for training graduates and instructional staff.

10 Test and fine-tune the modified program

Test the modified curriculum with one or two training intake groups and invite feedback from trainees and instructors. Fine-tune the program if necessary. At the outset of each intake (whether for the modified curriculum or the regular one), test trainees for their skill level in the one or two essential skills that are most salient.

11 Implement the final program

As mentioned above, this is the time—before training begins—to also collect key data on trainee characteristics.

12 Evaluate the program as per the evaluation strategy

Document the evaluation and consider sharing it with stakeholders.

Acknowledgements

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The Institute for Work & Health operates with the support of the Province of Ontario.

The views expressed in this guide are those of the authors and do not necessarily reflect those of the Max Bell Foundation or the Province of Ontario.

The development of the guide was led by a research team that included the following people and organizations:

- Institute for Work & Health—Dr. Ron Saunders, Dr. Curtis Breslin, Siobhan Cardoso, Morgane Le Pouésard
- Blueprint ADE—Dr. Karen Myers, Dr. Mark McKerrow
- Labourers' International Union of North America Local 506 Training Centre—Ted Gedney, Craig Gedney, Omar Passos
- Infrastructure Health & Safety Association—Shannon Hunt, Laura Shier
- Social Research and Demonstration Corporation
- Curriculum experts—Tracy Collins, Roger Duclos
- Essential Skills Group
- SkillPlan

The guide was developed in consultation with the following organizations:

- Infrastructure Health & Safety Association
- Public Services Health & Safety Association
- Workplace Safety North
- Workplace Safety & Prevention Services
- Training and Awareness Branch, Ontario Ministry of Labour

Appendix A:
Sample before-and-after training curriculum

The following provides examples of the before-and-after training curriculum with a focus on document use and numeracy. Other sections of the curriculum were also modified as part of the study, but are not included as examples due to length.

LEGEND

A yellow line indicates where new essential skills content has been added

A green line indicates where **new exercises** have been added

Baseline Participant Document Use Excerpt

Hoisting & Rigging Basic Safety

Duties of Workers (OHSA Section 28)

- **Work in compliance** with the provisions of the Act & Regulations
- **Use and wear**, equipment, protective clothing as required
- **Report** defective equipment
- **Not endanger self** or any other worker
- **Report** any contravention of Act or Regulations to supervisor

A **Competent worker** is defined in the Construction Regulations 213/91 as having knowledge, training and experience to perform specific work; knows the hazards in the work and is familiar with the legislation regarding the work

A **Signaller is** required under Regulations 213/91, Section 106 to:

- **Be a competent worker** performing no other work while signaling
- **Be trained** in duties as signaler in both written and verbal fonn
- **Wear** specific reflective vest
- **Be positioned** specifically to remain out of the path of the load and in view of the load, the operator, the landing point and all hazards
- **Remains in communication** with the operator

Rigger is defined in the ASME standard A 10.42-2000 as someone who:

- **Handles** rigging equipment and moves loads
- **Has knowledge, training and skill** to select, inspect and properly use rigging equipment
- May carry other occupational titles in specific trades sets.

Others may include Swamper. Oiler. Banksman

Rights of Workers (OHSA Section 43)

1. Right to _____
2. Right to _____
3. Right to _____

Legislation: Occupational Health and Safety Act

- In force since October 1, 1979 governing most Ontario work places
- Establishes workplace partnership of all parties to ensure health and safety of workers.
- Outlines the Internal Responsibility System (IRS)
- Details prescribed in Regulations written under the Act for each work sector
- Requires workers, supervisors and employers to share responsibilities for:
- Identifying H & S problems
- Developing H & S Policy and Program
- Establishing and cooperating with the H & S representatives (JHSC)

Employers, supervisors and workers have specific duties under the Occupational Health and Safety Act.

Duties of employers (OHSA Section 25 and 26)

- Ensure equipment, materials, protective devices as prescribed are provided and maintained in good condition
- Provide information, instruction and supervision
- Appoint a competent person to supervise and inspect
- Take every precaution reasonable to protect the health and safety of workers

Duties of Supervisors (OHSA Section 27)

Definition: A person who has charge of a workplace or authority over a worker.

- Ensure a worker works in a manner and with the protective devices prescribed in the Act and Regulations
- Ensure worker uses or wears equipment, protective devices
- Advise a worker of any actual or potential danger
- Take every precaution reasonable to protect the health and safety of workers

A **Competent person** is defined in the OHSA as having knowledge, training and experience to organize the work; is familiar with the legislation and knows the hazards in the work place.

Regulations

OHSA gives gives government powers to make Regulations under the Act

- Regulations set out the minimum control of common hazards
- Regulations are specific to each sector, and to specific hazards
- Examples: REGULATIONS under the OHSA:
- Construction projects 213
- Industrial Establishments 851

Standards

- Ensures products have the same characteristics, performance, definitions and terms, and are tested the same way
- Ensures training has same content, objectives and goals

Legislation Work Sheet

Read the following statements. Answer the question "Is it a true statement? Yes or No."

Instructor will guide you to legislation that accompanies the statements. Record the section number in the space provided.

1. An employer must supply equipment and maintain it in good condition to ensure the safety of workers
   ☐ Yes ☐ No OHSA Section #_____

2. A supervisor must do everything reasonable to ensure worker safety.
   ☐ Yes ☐ No OHSA Section #_____

3. Workers must immediately report any hazard and unsafe equipment or situation to the supervisor.
   ☐ Yes ☐ No OHSA Section #_____

4. No worker may store or move material in a way that could harm anyone.
   ☐ Yes ☐ No Regulation Section #_____

5. Operators may not pass a load over another worker unless it is to receive the load or to sink a shaft.
   ☐ Yes ☐ No Regulation Section #_____

6. A signaler must be assigned if any part of the load or boom may come within proximity to power lines.
   ☐ Yes ☐ No OHSA Section #_____

7. The signaller may not do any other work while signaling for an operator.
   ☐ Yes ☐ No OHSA Section #_____

8. The employer will ensure the signaler receives verbal and written instructions regarding a signaller's duties.
   ☐ Yes ☐ No OHSA Section #_____

9. Cranes and hoisting devices must not be over-loaded; must be used within their load carrying capacity.
   ☐ Yes ☐ No OHSA Section #_____

10. A guide rope (or tag line) must be attached to the load to prevent any uncontrolled movement.
    ☐ Yes ☐ No OHSA Section #_____

11. All slings and hardware used in hoisting equipment and materials must be rated at five times the maximum load capacity.
    ☐ Yes ☐ No OHSA Section #_____

12. Refer to the case study previously assigned to your group. Identify possible violations that may have contributed to the incident.
    OHSA Section #_____

Added: new content regarding how to use Act and legislation; methodology for locating information in Act/Regulations

Modified Participant Document Use Excerpt

NEW SECTION: Using Health and Safety Legislation

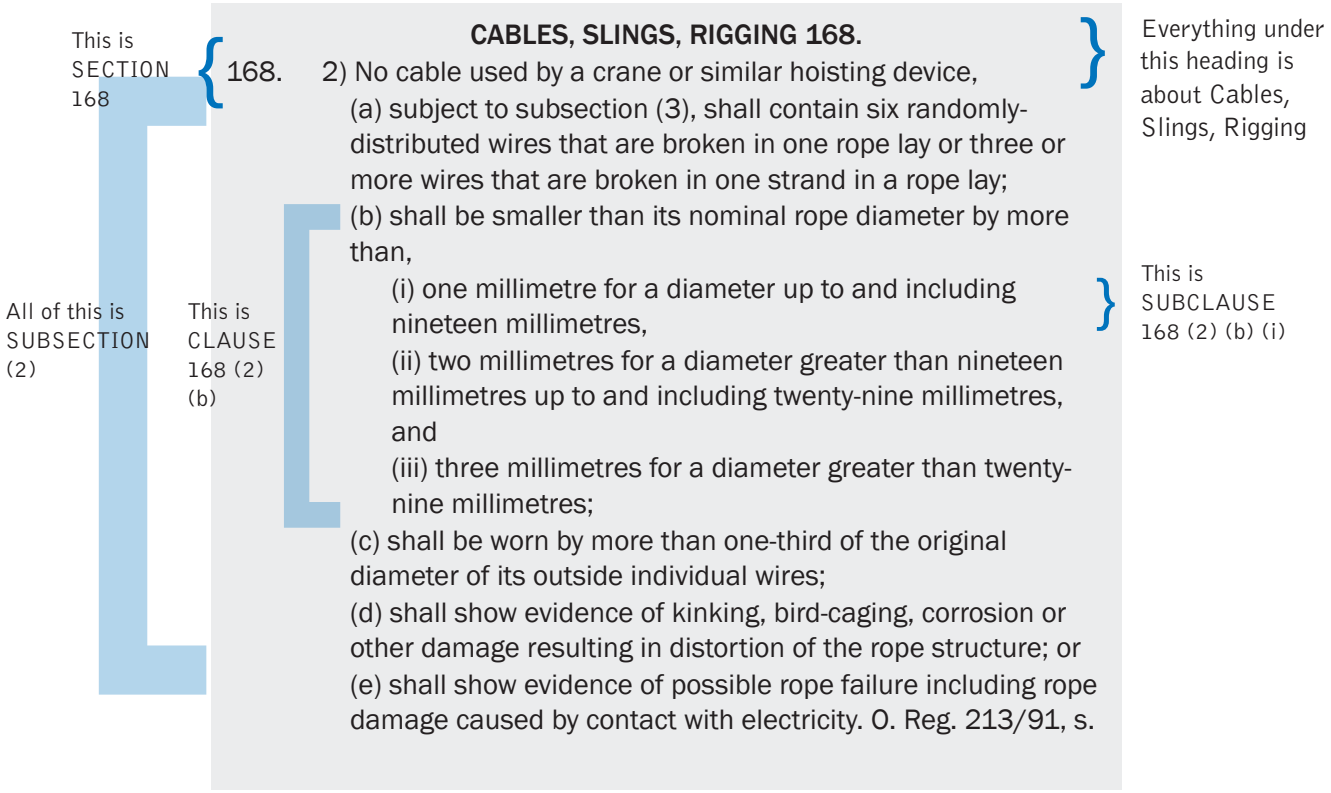
Health and Safety Legislation is organized using numbers and letters in the following hierarchy:

1. Section
   (1) Subsection
      (a)Clause
         (i) Subclause

The format is (mostly) consistent throughout the legislation documents. In this course, you may be using only the most relevant sections of the Act or Regulations (Appendix A), so numbers and letters in the format may not be continuous. Changes to legislation over time means items are removed or added. When items are removed, the remaining structure stays the same so users can still locate information where they did previously.

Example:

Note: When referring to a particular section, refer to it by the smallest division or subdivision used.



Use Index A at the back of your book (which contains sections from the Occupational Health and Safety Act and Ontario Regulation 213/91) to answer the following questions.

Use the following question strategy to locate information quickly and accurately.

Step 1: Identify key words
Step 2: Scan the Act or Regulations using the key words
Step 3: Locate the key words
Step 4: Decide the answer

Example 1: Whose duty is it to ensure that equipment, materials and protective devices are maintained in good condition?

Step 1: IDENTIFY the key words.
Whose *duty* is it to ensure that equipment, materials and protective devices are maintained in good condition?

Step 2: SCAN the sections of the Act using the key words: *duty, ensure, equipment, material, protective devices, maintained in good condition*.

Step 3: LOCATE the key words *duty, equipment, materials, protective devices,*

Duties Of Employers And Other Persons

Duties of employers

25.(1) An employer shall ensure that,
(a) the equipment, materials and protective devices as prescribed are provided;
(b) the equipment, materials and protective devices provided by the employer are maintained in good condition;
(c) the measures and procedures prescribed are carried out in the workplace;
(d) the equipment, materials and protective devices provided by the employer are used as prescribed.

Step 4: DECIDE that it is the **employer's** duty to ensure that equipment, materials and protective devices are maintained in good condition.

Example 2 : A crane operates near 175,000 volt power lines. What is the minimum distance that all objects must keep from the power lines?

Step 1: IDENTIFY the key words.
A crane operates near *175,000 volt* power lines. What is the *minimum distance* that all objects must keep from the power lines?

Step 2: SCAN the sections of the Regulations using the key words: *175,000 volts, minimum distance.*

Step 3: LOCATE the Electrical Hazard section of the Regulations.
Locate the key words *voltage* and *minimum distance* in the table in Subsection 188 (2).
Locate the key words more than *150,000 volts*, but no more than *250,000 volts*, and *4.5 metres* in the *minimum distance* column.

188. **(1)** This section applies unless the conditions set out in clauses 189 (a) and (b) are satisfied. O. Reg. 627/05, s. 7.
(2) No object shall be brought closer to an energized overhead electrical conductor with a nominal phase-to-phase voltage rating set out in Column 1 of the Table to this subsection than the distance specified opposite to it in Column 2.O. Reg. 627/05, s. 7.

TABLE

Column 1	**Column 2**
Nominal phase-to-phase voltage rating	Minimum distance
750 or more volts, but no more than 150,000 volts	3 metres
more than 150,000 volts, but no more than 250,000 volts	4.5 metres
more than 250,000 volts	6 metres

Step 4: DECIDE that **4.5 metres** is the minimum distance for all objects to keep from 175,000 volt power lines.

Added: practice exercises

Practice

Answer the following questions using the back Index and write the sections of the Act or Regulations in which you found the answer. Use the 4 step process:

- Identify
- Scan
- Locate
- Decide

1. What height must a fence be for public way protection?
2. How must material and equipment be piled or stacked?
3. Where workers should be positioned when receiving a load carried by a crane?
4. When may a worker refuse to use a piece of equipment?
5. Under what circumstances must operators of vehicles, machines and equipment be assisted by signallers?
6. What colour must a signaller's safety garment (shirt or vest) be?
7. What is the maximum number of broken wires in one rope lay in a wire rope used for rigging?
8. What is the minimum distance to maintain from 5,000 volt overhead power lines?
9. A worker arrived to a residential site in a delivery truck. He parked the truck on the street between two driveways. Working alone, he operated his boom crane using a remote control to unload the truck. During the course of unloading, the boom came in contact with an overhead power line of 750 volts. The worker was fatally electrocuted. What was done wrong?
10. A 23,000-pound box beam had been rigged using two web type synthetic slings in basket configuration. One sling slipped and the beam went down, causing the second sling to slip. The beam tumbled forward, killing the rigger. Investigation after the accident showed the beam was wet and greasy. One sling showed previous wear as abrasion, nicks, cuts and UV damage. As the beam slipped, friction between the beam and the first sling caused a cut in the sling. Although abrasion wear pads were used as softeners (edge protectors), the abrasion wear pads had melted and been cut through by the friction as they slipped with the slings. What was done wrong?

Legislation Work Sheet

Read the following statements. Answer the question "Is it a true statement? Yes or No."

Instructor will guide you to legislation that accompanies the statements. Record the section number in the space provided.

1. An employer must supply equipment and maintain it in good condition to ensure the safety of workers.
   ☐ Yes ☐ No OHSA Section #_____

2. A supervisor must do everything reasonable to ensure worker safety.
   ☐ Yes ☐ No OHSA Section #_____

3. Workers must immediately report any hazard and unsafe equipment or situation to the supervisor.
   ☐ Yes ☐ No OHSA Section #_____

4. No worker may store or move material in a way that could harm anyone.
   ☐ Yes ☐ No Regulation Section #_____

5. Operators may not pass a load over another worker unless it is to receive the load or to sink a shaft.
   ☐ Yes ☐ No Regulation Section #_____

6. A signaler must be assigned if any part of the load or boom may come within proximity to power lines.
   ☐ Yes ☐ No OHSA Section #_____

7. The signaller may not do any other work while signaling for an operator.
   ☐ Yes ☐ No OHSA Section #_____

8. The employer will ensure the signaler receives verbal and written instructions regarding a signaller's duties.
   ☐ Yes ☐ No OHSA Section #_____

9. Cranes and hoisting devices must not be over-loaded; must be used within their load carrying capacity.
   ☐ Yes ☐ No OHSA Section #_____

10. A guide rope (or tag line) must be attached to the load to prevent any uncontrolled movement.
    ☐ Yes ☐ No OHSA Section #_____

11. All slings and hardware used in hoisting equipment and materials must be rated at five times the maximum load capacity.
    ☐ Yes ☐ No OHSA Section #_____

12. Refer to the case study previously assigned to your group. Identify possible violations that may have contributed to the incident.

    Case Study #_____

    OHSA Section #_____

Baseline Participant Numeracy Use Excerpt

Hoisting & Rigging Basic Safety

Calculating Load Weights

The single most important precaution before attempting a lift is to determine the weight of the load.

Methods in Determining Load Weight

- Calculate from material weight
- Refer to drawings
- Refer to shipping documents
- Refer to equipment catalogues
- Look for painted, cast or welded posting on load
- Weigh it using weigh scales or using weighing device on crane

Example 1 - Spruce Lumber

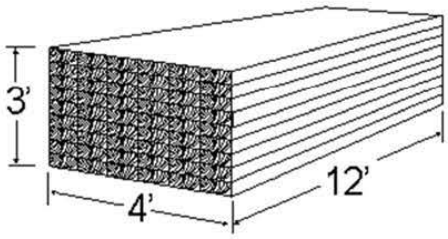
Volume = L x W x H

Weight

= L x W x H x Unit weight

= _____

= _____



Example 2 - Reinforced Concrete

Unit Weight = 150 lb. per cubic foot

A = L x W x H

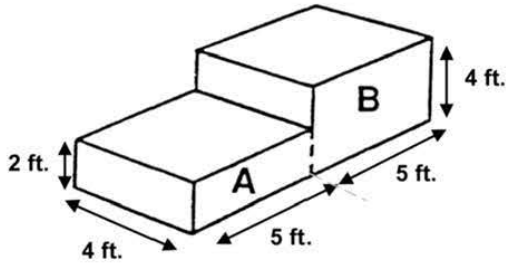
= _____

B = L x W x H

= _____

A + B

= _____



Hint: Separate the parts and calculate individually

Example 3 - Solid Steel Cylinder

Volume = π x r2 x L

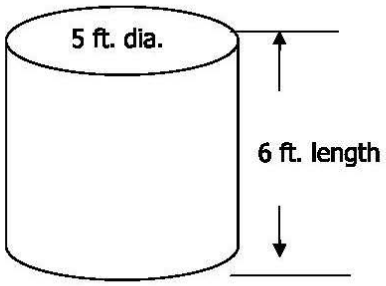
= 3.14 x r x r x Length

Weight

= 3.14 x r x r x L x unit weight

= _____

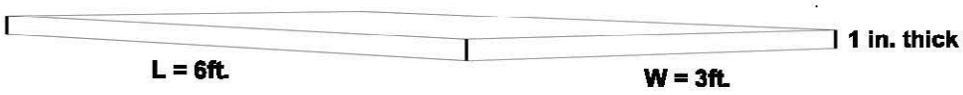
= _____



Hint: "r" is the radius, half of the diameter

Example 4-Steel Plate

Weight = L x W x H x Unit weight
= _____

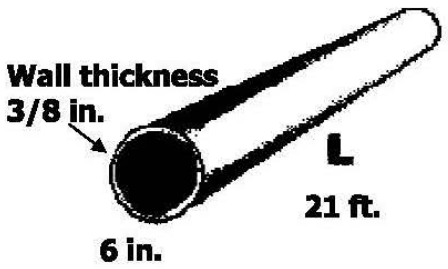


Example 5-Steel Pipe

Circumference
= π d
= 3.14 x _____

Area
= Circumference x Length
_____

Weight
= Area x thickness x unit weight
_____



Hint: Think of this as a flat sheet of steel rolled into a tube

Example 6 - Round Rod and Rebar
250 steel rods in a bundle.
Each rod is % in. diameter and 12 ft. long.
(Refer to M035 table 1.1)

Length of Rod X approx. weight per Unit
Length X Number of Rods

L x Unit Wt x Number of Rod
= _____

We have now completed eight examples working through volume, area and linear calculations.

To calculate weight of any load, ensure you can answer three questions:
- What is the shape?
- What are the dimensions?
- What is the material?

Modified Participant Numeracy Use Excerpt

Added: new explanation content for question calculation types (area, volume, length)

NEW SECTION: Calculating Load Weight

The single most important precaution before attempting a lift is to determine the weight of the load.

Methods in Determining Load Weight

- Calculate from material weight
- Refer to drawings
- Refer to shipping documents
- Refer to equipment catalogues
- Look for painted, cast or welded posting on load
- Weigh it using weigh scales or using weighing device on crane

For Load Weight Calculations, there are 3 types of questions:

- Calculating Weight Based on Volume
- Calculating Weight Based on Area
- Calculating Weight Based on Length

For each type of question, you'll refer to a separate table from M035

Load Weight Question Type	Table
Volume	1.2
Area	1.3
Length	1.1

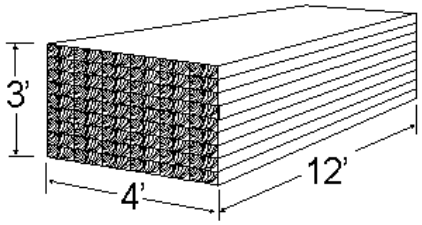
Steps to Solve:

Step 1: Complete the calculation using either Volume, Area, or Length
Step 2: Locate the unit weight in the correct table
Step 3: Calculate the weight
Step 4: Complete any required conversions

Added: updated all examples to include calculation sub-steps; Volume - 4 examples; Area - 3 examples; Length - 1 example

Calculating Load Weights Using Volume (Use Table 1.2 in M035)

Example 1
Calculate the weight of the spruce lumber.



Step 1: Complete the calculation
Volume of a rectangle

Volume = L x W x H
= 12 ft x 4 ft. x 3 ft
= 144 ft^3

Step 2: Use Table 1.2 (Volume) to find Spruce Lumber

Spruce Lumber = 28 lbs/ft^3

Step 3: Calculate the Weight

=144 x 28 lb.

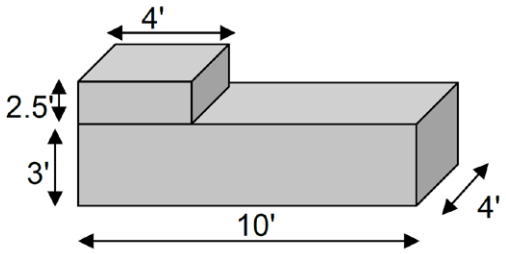
= 4,032 lbs

Example 2

Calculate the weight (in kilograms) of the pine lumber.

Step 1: Complete the calculation

Volume of 1 rectangle + 1 rectangle



Lower part $V = L \times W \times H$
$= 10' \times 4' \times 3' = 120\ ft^3$

Upper part $V = L \times W \times H$
$= 4' \times 4' \times 2.5' = 40\ ft^3$

Total volume $= 120\ ft^3 + 40\ ft^3 = 160\ ft^3$

Step 2: Locate the unit weight in Table 1.2.

Pine = 30 lbs/ft³

Step 3: Calculate the Weight

Weight = volume × unit weight
= 160 ft³ × 30 lbs/ft³ = 4 800 lbs

Step 4: Convert pounds to kilograms

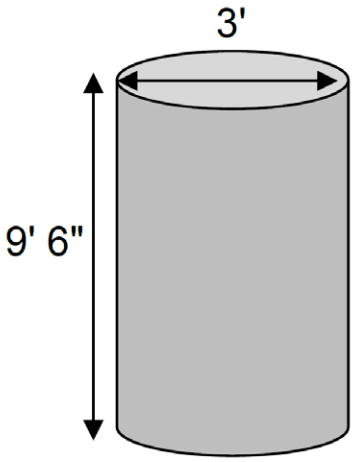
1 kg = 2.2 lbs

Note: To convert pounds to kilograms, divide by 2.2
To convert kilograms to pounds, multiply by 2.2

4 880 lbs ÷ 2.2 lbs/kg = **2 182 kg**

Example 3

Calculate the weight of the concrete column in kg.



Step 1: Complete the calculation

Volume of a cylinder

Note: To convert inches to decimal feet, divide by 12.

6” ÷ 12 = 0.5’

9’ 6” = 9.5’

r = d ÷ 2 = 3’ ÷ 2 = 1.5’

$V = \pi \times r^2 \times H$

$= 3.14 \times 1.5' \times 1.5' \times 9.5' = 67.1175\ ft^3$

Note: 3.14 was used for π. If you use 3.14159 or the π button on the calculator, you will get a slightly different answer.

Step 2: Locate the unit weight in Table 1.2.

Concrete, stone, reinforced = 150 lbs/ft³

Step 3: Calculate the weight.

Weight = volume × unit weight

= 67.1175 ft³ × 150 lbs/ft³ = 10 067.625 lbs

Step 4: Convert lbs to kg.

1 kg = 2.2 lbs

Note: To convert pounds to kilograms, divide by 2.2.

To convert kilograms to pounds, multiply by 2.2.

10 067.625 lbs ÷ 2.2 lbs/kg **= 4 576.193182 kg**

Example 4
Calculate the weight of the steel plate.

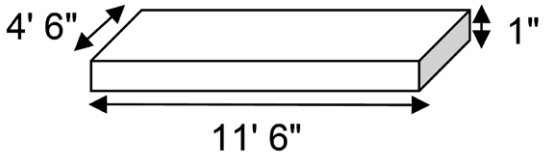
Step 1: Complete the calculation

Volume of a rectangle.

Note: Weight of materials in tables are usually stated in lbs/ft³ or kg/m³. The steps for calcuating weight are the same for metric and imperial dimensions. The unit weight factor is different.

Convert inches to decimal feet.

Note: to convert inches to decimal feet, do inches ÷ 12.



4’ 6” = 4.5’
1” = 0.083’
11’ 6” = 11.5’

V = L × W × H = 11.5’ × 4.5’ × 0.083’ = 4.29525 ft³

Step 2: Locate the unit weight in the Table 1.2.
Steel = 490 lbs/ft³

Step 3: Calculate the weight.
Weight = Volume × unit weight = 4.29525 ft³ × 490 lbs/ft³ = 2 105 lbs

Calculating Load Weights Using Area (Use Table 1.3 in M035)

When weights are based on area and a standard size or gauge:

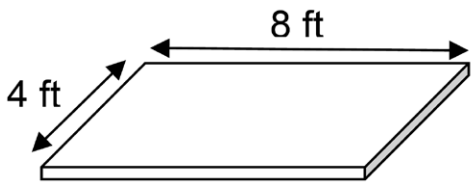
- Weight = area × unit weight in lbs/ft^2
  - Calculate the area in ft^2
  - Convert the area to weight

When weights are based on area and thickness in inches:

- Weight = area × thickness in inches × weight in lbs/ft^2
  - Calculate the area in ft^2
  - Convert the area to weight

Example 1:

Calculate the weight of a solid 2” gypsum-sand plaster partition with the following dimensions.



Step 1: Calculate the area.

Area = L × W = 8 ft × 4 ft = 32 ft^2

Step 2: Locate the unit weight in *Table 1.3 Weights of Materials (Based on Surface Area).*

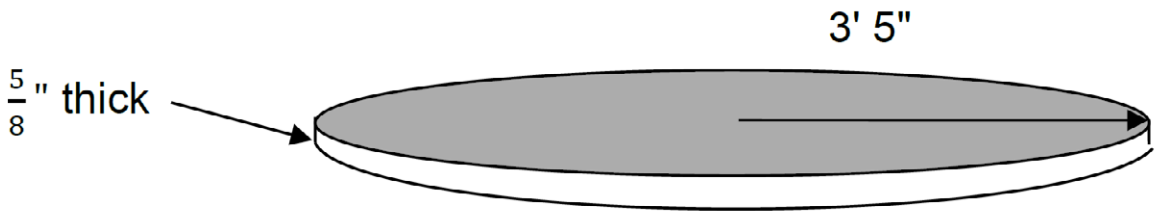
Solid 2” gypsum-sand plaster = 20 lbs/ft^2

Step 3: Calculate the weight.

Weight = area × unit weight/ft^2

= 32 ft^2 × 20 lbs/ft^2 = 640 lbs

Example 2:
Calculate the weight in kilograms of a steel plate with the following dimensions.



Step 1: Calculate the area.

Convert feet and inches to decimal feet

Note: To convert feet and inches to decimal feet, do inches ÷ 12.

5” ÷ 12 = 0.417’

3’ 5” = 3.417’

Area = πr2 = 3.14 × 3.417’ × 3.417’ = 36.66229146 ft2

Note: 3.14 was used for π. If you use 3.14159 or the π button on the calculator, you will get a slightly different answer.

Step 2: Locate the unit weight in *Table 1.3 Weights of Materials (Based on Surface Area).*

Steel plate (per inch of thickness) = 40 lbs/ft^2

Step 3: Calculate the weight.

Convert fraction of an inch to decimal inches.

Note: To convert a fraction to decimal inches, always do top ÷ bottom.

⅝” = 5 ÷ 8 = 0.625”

Weight = area × thickness in inches × 40 lbs/ft^2

= 36.68088711 ft2 × 0.625” × 40 lbs/ft^2 = 917.0221777 lbs

Step 4: Convert lbs to kilograms.

1 kg = 2.2 lbs

Note: To convert pounds to kilograms, divide by 2.2.

To convert kilograms to pounds, multiply by 2.2.

917.0221777 lbs ÷ 2.2 lbs/kg = **417 kg**

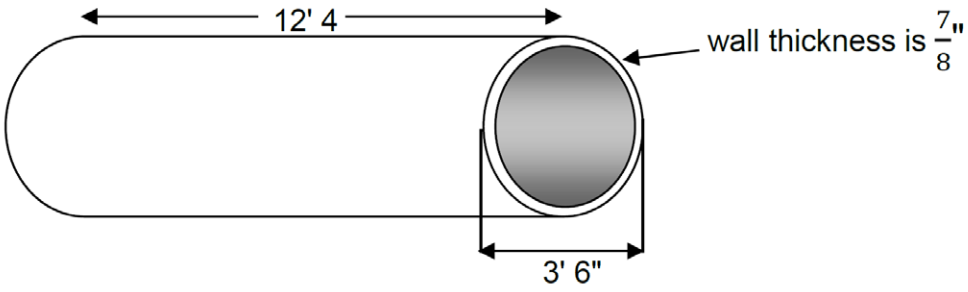
Example 3:

Calculate the weight of the steel pipe in kg.

The diameter is 3’ 6”.

The length is 12’ 4”.

The wall thickness is 7/8”.



Step 1: Complete the calculation

Calculate the surface area of the pipe.

The pipe is a rolled up rectangle with the same length. The width is equal to the circumference (π × d).

Convert inches to decimals of a foot.

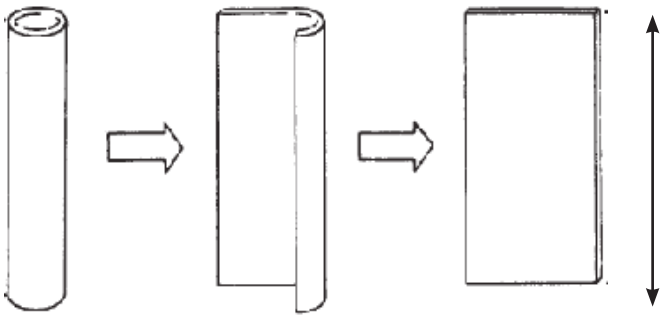
3’ 6” = 3.5’

12’ 4” = 12.333’

Area = π × d × L

= 3.14 × 3.5’ × 12.333’

= 135.53967 ft²



Note: 3.14 was used for π. If you use 3.14159 or the π button on the calculator, you will get a slightly different answer.

Step 2: Locate the unit weight in *Table 1.3 Weights of Materials (Based on Surface Area).*

Steel plate (per inch of thickness) = 40 lbs/ft²

Step 3: Calculate the weight.

Convert fractions of an inch to a decimal.

Note: To convert a fraction to decimal inches, always do top ÷ bottom.

⅞" = 7 ÷ 8 = 0.875"

Weight = Area × thickness in inches × unit weight/ft2
= 135.53967 ft² × 0.875" × 40 lbs/ft² = 4 743.88845 lbs

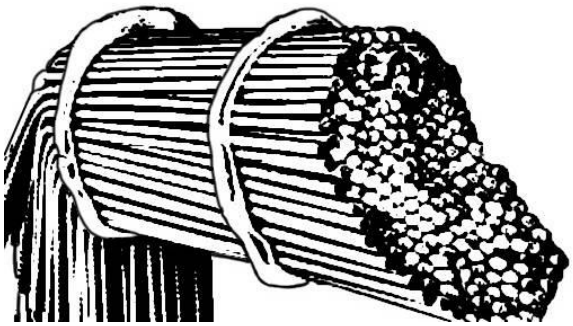
Step 4: Convert lbs to kgs.

1 kg = 2.2 lbs

Note: To convert pounds to kilograms, divide by 2.2.
To convert kilograms to pounds, multiply by 2.2.

4 743.88845 lbs ÷ 2.2 lbs/kg = **2156 kg**

Calculating Load Weights Using Length (Use Table 1.1 in M035)



Example 1:
Calculate the weight in kilograms of a bundle of rebar. The bundle contains fifteen bars with a diameter of 1¼ “. The bars are 12’ 4” long.

Step 1: Convert 12’ 4” to decimal feet.

Note: To convert inches to feet, divide inches by 12.

4” ÷ 12 = 0.333’

12’ 4” = 12.333’

Step 2: Locate the unit weight in *Table 1.1 Approximate Weight per Foot of Length of round Steel Bars and Rods.*

1 ¼” = 4.17 lbs per foot of length

Step 3: Calculate the weight.

Weight = # of bars × length × unit weight (lbs/foot)

= 15 × 12.333’ × 4.17 lbs/ft = 771.42915 lbs

Step 4: Convert the weight to kilograms.

1 kg = 2.2 lbs

Note: To convert pounds to kilograms, divide by 2.2

To convert kilograms to pounds, multiply by 2.2

771.42915 lbs ÷ 2.2 lbs/kg **= 351 kg**

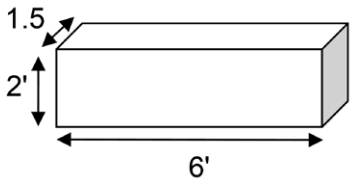
Added: 18 new exercise questions

Practice

Round off answers to the nearest whole pound or kilogram.

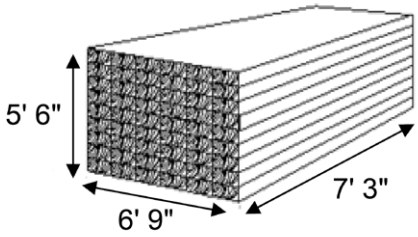
1)Reinforced concrete

Weight = _____ lbs



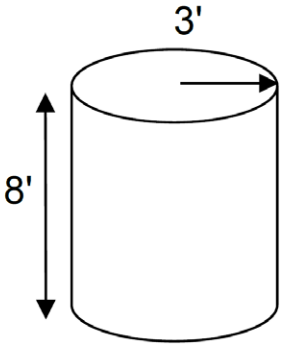
2)Pine timber

Weight = _____ lbs



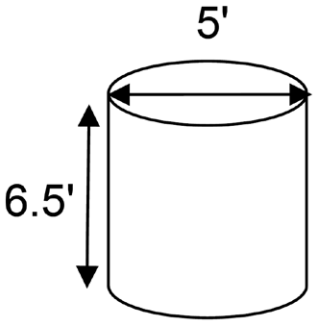
3)Reinforced concrete

Weight = _____ kg



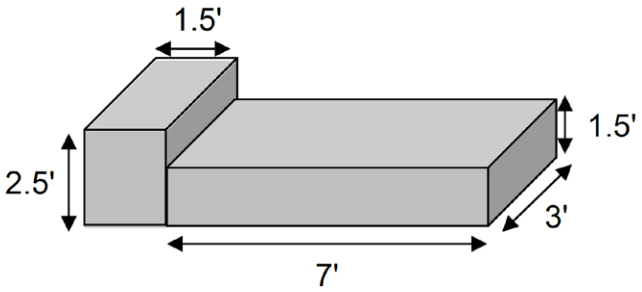
4)Reinforced concrete

Weight = _____ kg



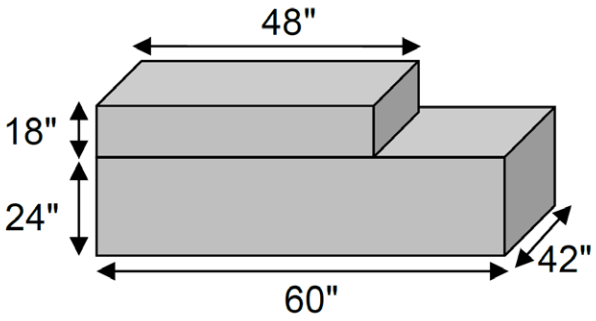
5)Steel

Weight = _____ lbs



6)Fir, Douglas, wet

Weight = _____ kg



7.Calculate the weight of asphalt shingle roofing that measures 15’ long and 7.38’wide. Convert pounds to kilograms.

8.Calculate the weight of a 1 1/2”, 14 ga. steel roof deck that measures 20’ longand 14’ wide. Convert pounds to kilograms.

9.Calculate the weight of a steel plate that measures 5’ 3” by 4’ 6” and is 5/8” thick. Convert pounds to kilograms.

10.Calculate the weight of a steel plate that has a diameter of 39” and is ¼”thick. Convert pounds to kilograms.

11.Calculate the weight of a glass plate that has a radius of 60” and is ¼” thick. Convert pounds to kilograms.

12.Calculate the weight of a steel pipe with the following dimensions:

Diameter = 6”
Length = 15’ 3”
Walls = 3/8” thick

Convert pounds to kilograms.

13.Calculate the weight of a steel pipe with the following dimensions:

Diameter = 2’
Length = 18’
Wall = 1” thick

Convert pounds to kilograms.

14.Calculate the weight of a bundle of 15 pipes with the following dimensions:

Radius = 1’ 6”
Length = 14’ 10”
Wall = ¾ “ thick

Convert pounds to kilograms.

15.Calculate the weight of 20 bars with the following dimensions.

Diameter = 1”
22 ft long

Weight = _____ lbs

16.Calculate the weight of 50 bars with the following dimensions.
Diameter = 3/4”
15 feet long

Weight = _____ lbs

17.Calculate the weight of 8 bars with the following dimensions.

Diameter = 1 1/2”
10’ 6” long

Weight = _____ kg

18.Calculate the weight of 37 bars with the following dimensions.

Diameter = 1 1/4 “
20’ 3” long

Weight = _____ kg

We have now completed examples working through volume, area and linear calculations. To calculate weight of any load, ensure you can answer three questions:

- What is the shape?
- What are the dimensions?
- What is the material?

Appendix B: Sample interview and observation evaluation questions

Sample questions for instructor interview, trainee interview, and worksite observation guidelines

The following are sample interview questions when conducting a "qualitative" analysis of your training intervention. These sample questions should be tailored to the areas that your organization wishes to evaluate.

Sample instructor interview questions

General questions (can be asked before curriculum modification):

1. What factors are important to consider in the delivery of training programs to learners? [prompt: discuss barriers/enablers, trainee education, language skills, prior experience with education]
2. How would you describe trainees' essential skills levels and needs? [prompt: education levels, language skills, general learning needs]
3. In your experience, what teaching approaches work well with trainees? [prompt: teaching methods, accommodations]
4. If you see trainees are struggling, how you do assist them with their learning?
5. What are barriers/enablers to trainees applying training on a worksite?

Questions about modified curriculum:

1. How well did the class work with the new components of the curriculum?
2. What changes would you suggest to these components?
3. Are there any other changes to the course you would suggest?

Sample trainee interview questions

1. Tell us what you thought of the training program you just completed. Have you been able to apply what you learned during the training at work?
2. Should the training program go into more/less detail? [prompt for different components of learning]
3. In your opinion, how was the training program delivery in terms of effectiveness, level of difficulty, and pace?
4. What parts of the training program would you change?
5. Do you feel confident in your ability to perform at work what you learned during the training? [prompt: with supervision, alone]

Sample worksite observation guidelines

Observing trainees on the worksite may provide insight into the effectiveness of the training program.

- Are workers using steps/techniques/methods outlined in the training to complete their tasks?
- Do workers seem to be using alternatives to steps/techniques/methods outlined in the training? [document what alternate methods they are using to perform tasks]
- If workers are not performing tasks as taught in the training, why not?

If possible, consider interviewing a manager or supervisor, focusing on the following questions:

- Are you aware of any learning needs among your workers? [prompt for awareness of essential skills needs]
- Are you aware of any barriers to applying training in your workplace?
- Have you received feedback from your workers regarding training?
- How do you support workers performing newly learned job tasks? [prompt for mentorship, shadowing etc.]
- Are there aspects of the work that you think need to be covered in more/less depth during training?
- Have you noticed a difference in workers' performance following training?

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