HOW TO BE A CONSTRUCTIVE WORKER IN CONSTRUCTION

A SELF-LEARNING TOOL FOR THE BEGINNERS

FIRST EDITION

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National Library of Sri Lanka

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This book will be highly beneficial for both local and international readers. The contents were written in a style that helps the reader to easily fix the learnt contents into his/her mind with a feel and proper understanding. Though the main readers of this book can be the construction workers, this book is also highly beneficial for the students who begin their job careers in the construction field after their school education. Further, this book can be a useful tool for construction engineers and managers to properly monitor the direction of the performance of workforce operations.

Dedication

This book is dedicated to

each construction worker in the world whose performance in work operations is adequate for the productivity improvement of the work outputs

and

each construction firm who is very keen to upgrade the skill development practices for the new normal of the industry

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"Inspire reading and create a knowledge society"

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"How to be a constructive worker in construction: A self-learning tool for the beginners" by Manoharan et al.

Preface from the Authors

The increasing pace of globalisation and technological advancement expand various employment opportunities for the economic growth of many countries. Construction is a labour-intensive sector, and it generates a large number of employment opportunities in a range of related sectors for the achievement of national socio-economic goals. Labour is the most valuable asset in the construction industry, but the construction sector of many countries has been facing work productivity-related problems due to skill shortages. The qualification levels of the workforce, their work performance and working quality standards are the very important factors that determine the productivity outcomes of the work operations in construction activities. These are the key components that adapt the industries to face the challenges and opportunities of globalisation and the next industrial revolution.

Job performance, work standards and qualification levels can be improved through upgrading the education, training facilities and work methods. But, many sources highlight the industry's lack of focus on improving training facilities for workers in construction. Worker skill shortages, workers' poor education background and their lack of work experience are the significant factors that affect the performance of work outputs. Due to the skill shortages, unskilled workers work as skilled workers in construction projects in many countries, including Sri Lanka.

Considering the construction industry practices of many developing countries like Sri Lanka, a wide range of cognitive, transferable and self-management skills of the construction workers have not been up to the required standards. Though the industry feels the impacts of these problems, most organisations do not take the necessary steps to address those problems appropriately in the construction industry. There have been no proper systems found to evaluate work skills at worksites. Developing skill improvement practices and performance evaluation methods for workers, and their proper execution at worksites are the mandatory requirements for the construction firms to overcome the challenges related to poor performance of workers.

The authors of this book have conducted excessive research with a wider scope to address the above-mentioned problematic areas and the needs of the industry. Especially, a new labour training programme guide model has been introduced by the authors with the scope of improving productivity and performance of work operations in construction. The developed labour training guide model includes a set of work-based training exercises, which were designed through comprehensive approaches. Providing work-based training tasks through effective supervision practices will be highly beneficial to the industry for improving the performance of workers at construction sites. The authors have also introduced a guide tool for preparing the supervisors to train workers through systematic approaches at worksites. This may lead to taking necessary actions for a fundamental change in the way that the construction workforce lives, works and relates to another, considering the long term-based sustainability of the construction industry.

A framework called 'Labour Performance Score (LBPS) system' is another milestone that the authors have presented to assess workers' competencies towards the calculations of labour performance score values and labour grading. The developed framework allows the construction management team to measure the performance of workers through a comprehensive procedure. The LBPS framework can be a functional tool for the construction industry that provides a mechanism to show the detailed cross-section of each worker's performance and values and also displays their roles and responsibilities to accelerate the next normal in construction. It also shows a systematic path to assess workers' competencies according to the National Vocational Qualification (NVQ) levels through implementing the Recognition for Prior Learning (RPL) methods at construction sites. As a result, a set of productive-based practices related to worker skills assessments and rewards can be performed on construction sites. The organisations may experience a significant improvement in the productivity and performance of their workforce operations, leading to promotion opportunities, salary increment packages and other career development benefits for workers. In addition, a gradual rise is expected in the skilled worker supply in the

construction sector, also a significant improvement in the worker motivation level and quality of work operations.

The detailed information about the application of the above-developed guide models/frameworks and other significant research findings of the authors can be read in the following research articles.

- Manoharan, K., Dissanayake, P.B.G., Pathirana, C.K, Deegahawature, M.M.D.R. and Silva, K.D.R. (2020), Assessment of Critical Factors Influencing the Performance of Labour in Sri Lankan Construction Industry, International Journal of Construction Management (IJCM) (Taylor & Francis Publishers). https://doi.org/10.1080/15623599.2020.1854042
- Manoharan, K., Dissanayake, P., Pathirana, C., Deegahawature, D. and Silva, R., (2021), Comparison of Skills between Sri Lankan and Foreign Construction Labour. In: Sandanayake, Y.G., Gunatilake, S. and Waidyasekara, K.G.A.S. (eds). Proceedings of the 9th World Construction Symposium, 9th-10th July 2021, Sri Lanka [Online], pp. 208-220. https://doi.org/10.31705/WCS.2021.18
- Kesavan, M., Dissanayake, P.B.G., Pathirana, C.K., Deegahawature, M.M.D.R. and Silva, K.D.R. (2021), A Study on Knowledge, Skills and Abilities of Labourers Affecting the Performance of Building Construction Projects in Sri Lanka, ENGINEER Journal of Institution of Engineers Sri Lanka, Volume 54, Issue 3, pp. 17-26. http://doi.org/10.4038/engineer.v54i3.7456
- Manoharan, K., Dissanayake, P.B.G., Pathirana, C.K, Deegahawature, M.M.D.R. and Silva, K.D.R. (2021), A Curriculum Guide Model to the Next Normal in Developing Construction Supervisory Training Programmes, Built Environment Project and Asset Management (BEPAM) (Emerald Publishing). https://doi.org/10.1108/BEPAM-02-2021-0038
- Manoharan, K., Dissanayake, P., Pathirana, C., Deegahawature, D. and Silva, R. (2021), A Competency-based Training Guide Model for Labourers in Construction, International Journal of Construction Management (IJCM) (Taylor & Francis Publishers). https://doi.org/10.1080/15623599.2021.1969622
- Manoharan, K., Dissanayake, P., Pathirana, C., Deegahawature, D. and Silva, R. (2022), A Labour Performance Score and Grading System to the Next Normal Practices in Construction, Built Environment Project and Asset Management (BEPAM) (Emerald Publishing) https://doi.org/10.1108/BEPAM-10-2021-0125

Significance of this Book

This book was comprehensively designed based on the above-discussed research outcomes that exactly address the industry's needs at the current and future stages. This book will be very useful for both construction supervisors and construction workers for the delivery of the well-developed work-based training exercises from the above-mentioned research. Each unit of this book was designed with the proper explanations and descriptions of the required contents for each training exercise. Especially, the contents were written in a style that helps the reader to easily fix the learnt contents into his/her mind with a feel and proper understanding. The book promotes self-learning among construction workers, also making them get proper guidance and advice from the construction supervisory workers for their learning. This allows the construction workers to improve their job performance, considering their work process, learning abilities and responsibilities under each training element of outcome, as shown in the following table. Overall, the units/chapters focus on developing the required fundamental cognitive skills of workers for performing well in construction activities. Considering the workers' manual skills, the units/chapters mainly focus on improving their ability to imitate a displayed behaviour or utilizing trial and error. Some contents focus on their ability to skillfully perform complex patterns of actions too. The abilities to utilise selected attention, awareness of feelings, emotions and active participation are the attitude levels of workers that are focused in each unit/chapter.

Unit	Aim / Objectives	Training Elements of Outcomes (TEOs)
1	Improving the soft skills of workers required in the construction works	TEO 1.1: Workers perform activities with the required work-related transferable skills at construction sites (Learning; Reading, writing and listening; Leadership; Teamwork; Communication; Memorisation; Innovative thinking; Analytical skills and abilities).
		TEO 1.2: Workers perform activities with the required work-related self-management skills at construction sites (Adapting to changes in new environments; Critical reasoning; Problem-solving; Decision making;

		Psychology; Reduction of alcohol and drug usage; Commitment; Self-motivation; Punctuality).
2	Improving the performance of workers in understanding and application of basic science and technology related practices	TEO 2.1: Workers assist with the tasks related to measurements and estimation in the construction.
		TEO 2.2: Workers carry out their works with the proper understanding of construction drawing.
		TEO 2.3: Workers use appropriate ICT applications for easy work operations.
3	Improving the performance of workers in understanding of simple engineering and technology related practices	TEO 3.1: Workers carry out their works with the proper understanding of simple structural and architectural concepts.
		TEO 3.2: Workers assist with the tasks related to flow measurements, soil testing and surveying procedures.
		TEO 3.3: Workers use electrical sources following safety regulations.
4	Improving the performance of workers on understanding and application of technologies used and methods followed in construction works	TEO 4.1: Workers follow health and safety guidelines in all types of construction works at the job site.
		TEO 4.2: Workers carry out construction operations with the proper cognitive and manual skills in technologies used.
		TEO 4.3: Workers handle the equipment properly in machinery operations.
5	Improving the material handling abilities of workers	TEO 5.1: Workers use construction materials in work operations with a basic understanding of the properties and behaviour of materials.
		TEO 5.2: Workers handle tools to properly follow the procedures in material testing activities.
6	Improving the performance of workers in applying green practices in construction	TEO 6.1: Workers follow the green practices in their work operations (eg. water supply, waste disposal, material usage, etc.) with the understanding of the importance of environmental sustainability.
		TEO 6.2: Workers explain the importance of the application of energy conservation methods and other green practices to co-workers.

7	Improving the management related skills/abilities of workers required in construction works	TEO 7.1: Workers follow the guidelines/procedures related to quality assurance and controlling practices in their work operations.
		TEO 7.2: Workers manage themselves to strengthen their financial background for personal life aspects.
		TEO 7.3: Workers follow the aspects of labour laws for career benefits.

Considering the overall benefits and implications of this book, this may lead to securing the jobs for workers as well as ensure the higher performance of work operations towards higher productivity, profitability and sustainability of the organisations for the successful long run in the industry. As a result, necessary training facilities, rewarding mechanisms, proper incentives, promotion opportunities and welfare facilities are expected to be implemented at the organisational level for construction workers.

Foreword from the Book Review Experts

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The reviewers highly appreciate the efforts taken by the authors of this book, who have focused on developing methods through comprehensive research to tackle labour skill shortages which is one of the most important issues faced by the construction industry in developing countries like Sri Lanka. The book displays the image that clearly illustrates how construction workers should be prepared to adapt to the new defaults of the construction industry in developing countries. In particular, the authors expect to develop the performance of construction workers for making significant improvements in productivity levels of the construction process on a long-term basis. To this end, the authors have provided a new curriculum that develops the skills of construction workers in a variety of aspects for long-term use.

The contents of this book are mainly divided into seven chapters, where each chapter sets out its objectives and the levels of work-based training components that are expected as learning outcomes. Each training component has been designed to bring about systematic changes in the work ethic, learning needs and expression of responsibilities of construction workers. Overall, the content of the book shows the cross-section of the knowledge, skills and behaviours of construction workers expected for upgrading the industry's current practices to the new normal situations.

"How to be a constructive worker in construction: A self-learning tool for the beginners" by Manoharan et al.

The style in which the contents of the book are written has been designed to help readers for improving their knowledge with easy understanding and a sense of directness in applying what they have learned in their work processes. Furthermore, the book aims at developing self-learning activities among construction workers and sowing seeds for their long-term learning activities.

The book has been designed to be of considerable use to employees working in various professions on construction sites. The book serves as an easy tool for implementing workforce development training practices on construction sites. This book will be very useful for construction workers and construction supervisors for it. It will also be very useful for the students who have completed their schooling and begun their job career in the construction field to easily learn and understand the basics of construction work. In addition, construction engineers and construction managers may also use this book as a special tool to consistently monitor the performance of work operations.

This book makes a significant contribution to developing effective skill development practices for construction workers. The book recommends new industry practices for the construction sector such as performance evaluation methods, a new labour grading system and the mechanism for obtaining recognition and other rewards for them expeditiously, and their implementation. Civil engineers and construction managers working in construction companies can apply the above structural approaches to their workplace practices by referring to the recently published research articles of the authors of this book.

Furthermore, the book plays a major role in achieving the national goals and greatly contributes to the restructuring the construction education and training practices. In particular, the book provides a number of key features that will enable the industry to achieve significant and lasting changes in the performance of domestic human resources in the short term.

The features mentioned above confirm the value and the uniqueness of this book and further enhance the overall impact of the book. Given the uses and implications of this book, it is strongly recommended by the book reviewers that construction companies use this book as an important tool for the skill and performance development of their workers.

Acknowledgements

This book was designed based on research conducted on the performance of construction workers, as mentioned in the preface of the authors. The authors are grateful to the construction experts from governmental and non-governmental sectors, who actively participated in the interviews, surveys, workshops and discussion sessions for the research conducted.

The authors would not be able to get the work done without the continual support given by the University of Peradeniya and Wayamba University of Sri Lanka. The authors also wish to acknowledge the Tertiary and Vocational Education Commission of Sri Lanka, Vocational Training Authority of Sri Lanka and Construction Industry Development Authority for the valuable assistance provided to the research conducted.

Finally, a special acknowledgement goes to the construction supervisory workers, who have been actively involved in the delivery of work-based training exercises and skill assessments at some selected construction sites based on the contents provided in this book. Notably, these construction supervisory workers are the students of Batch 1 of the 'Diploma in Construction Labour Productivity and Performance Management (DCLPPM)' which was developed using the guide models published in research articles (mentioned in the preface of the authors). The DCLPPM programme is currently delivered by the Faculty of Technology of the Wayamba University of Sri Lanka.

Table of Contents

Unit 1
Development of Construction Workers' Soft Skills

This unit helps the construction workers for improving their soft skills required in the construction works. The contents included in this unit will be very useful for the construction supervisors to provide necessary work-based training exercises and conduct performance evaluations of workers towards the following elements of training outcomes.

The workers will be able to

- perform activities with the required work-related transferable skills at construction sites (learning; reading, writing and listening; leadership; teamwork; communication; memorisation; innovative thinking; analytical skills and abilities).
- perform activities with the required work-related self-management skills at construction sites (adapting to changes in new environments; critical reasoning; problem-solving; decision making; psychology; reduction of alcohol and drug usage; commitment; self-motivation; punctuality).

This unit provides necessary procedures, explanations and solution guidelines that need to be followed by the construction workers for the following questions.

- How can I be a good learner?
- How can I improve my reading, writing and listening abilities?

- How can I adapt myself to the changes in a new work environment?
- How can I improve my critical reasoning?
- How to improve my problem-solving skills?
- How can I be a good decision maker?
- How can I be a good team player?
- How to improve my leadership skills?
- How to improve my psychology?
- How to improve my physical ability?
- If I am an alcohol/drug user or smoker, how can I reduce this habit?
- How can I improve my self-motivation and commitment to work?
- How can I be punctual?
- How can I improve my communication skills?
- How can I improve my memorisation?
- How can I be an innovative thinker?
- How can I improve my analytical skills?

1.1. How can I be a good learner?

I need to

- be curious in learning subject contents.
- understand my self-learning abilities as my self-responsibility.
- be eager to ask the questions to myself for finding the solutions (If I could not find the right solutions, I need to get help from someone who has good knowledge or experience in the relevant area).
- develop my thinking abilities with a wide range of positive thoughts.
- be eager to identify my strengths and weaknesses for improving my abilities.

"Never stop watering this tree"

1.2. How can I improve my reading, writing and listening abilities?

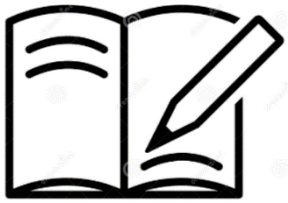
First, I need to understand the importance of reading, writing and listening abilities for my learning process towards the improvement of my knowledge.

When I have free time, I need to spend it reading the articles. I can find so many articles (books, essays, newspapers, magazines, etc.) on the internet.

"Why don't I regularly visit the library to find some interesting articles? Let's do so. I can also make my co-workers and friends join me."

To improve my writing skills, I need to

- pay more attention to the structure of each sentence in my writing.
- use the punctuations correctly.
- improve my grammar.
- avoid repeating the same ideas / concepts again and again in my writing.



To improve my listening skills, I need to

- pay more attention to what others say.
- understand the reasons and the required actions behind the listened contents.

"Reading is like breathing in, writing is like breathing out"

1.3. How can I adapt myself to the changes in a new work environment?

I need to

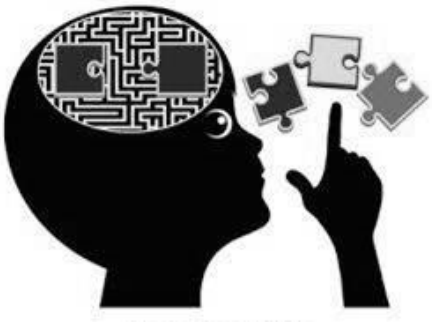
- identify the new challenges to be faced and reinforce my abilities to face those successfully.
- be self-confident and follow the 'can do' approach.
- understand my roles and responsibilities in the work environment.
- avoid my involvement in unnecessary activities, that may be harmful to my future.
- be friendly with my other co-workers and always be supportive to do good things.
- assess my processes by asking the following questions.
    - Am I doing a good job for my organisation?
    - Am I doing the right thing for my family members and friends?
    - Am I doing my job with happiness and self-satisfaction?
    - Am I strengthening my abilities considering future purposes?
    - Am I strengthening my financial background?

"Work hard, stay positive"

1.4. How can I improve my critical reasoning?

I need to

- improve my attentiveness in knowing new things.
- be always aware of what happens around me.
- discuss the critical matters with others and understand the perspectives of different parties. This will improve my thinking and analytical abilities too.
- have the ability to select the right approaches for my actions.
- think always about my approaches considering the practicality and applicability in real situations.



"The value of the education is not the learning of many facts; it is the training of the mind to think"

1.5. How to improve my problem-solving skills?

I need to

- reach the required knowledge level with improved critical reasoning.
- follow the proper guidelines and procedures in my work tasks.
- be keen on applying my knowledge and skills in my work tasks.

- be always aware of the possibilities of human errors in work tasks.
- understand the characteristics and the depths of the problems.
- ask questions many times to find out the exact causes of problems.
- discuss the problems with my supervisors to find out possible solution methods.
- consider the practicality of the solution methods to the real situations.
- assess my processes considering the wealth of my organisation and other sectors.

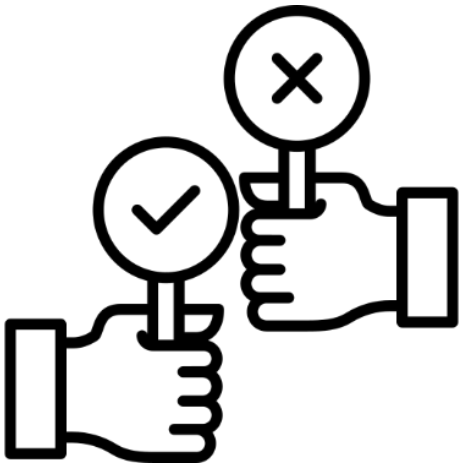
"Always try to solve the problem from its root, lest it springs again"

1.6. How can I be a good decision maker?

I need to

- think first whether I am the suitable person to decide on a particular matter.
- collect the necessary information and do proper analysis on those before taking my decision.
- be aware of the expected outcomes in my decision-making process.

- think myself several times about whether I identified the right things for the actions.
- ask myself whether I am strong and satisfied with the decided contents.
- Re-assess the critical matters of my decision-making process by discussing them with the experts.



"A successful decision-making relies on a balance between deliberate and instinctive thinking"

1.7. How can I be a good team player?

I need to

- understand the differences between the outcomes of working as an individual and a team.
- respect the human feelings, expressions and needs.
- discuss with my team members to get their opinions for making the right decisions.
- share my past experiences and learnt things with my team members.
- improve my attitude of giving up for my team members.
- be a person who rejoices in the progress of others.
- develop my coordinating skills to perform tasks as a team.

- develop my ability to compromise with others and express my team spirit.
- make opportunities for my team members.

"A successful team is a group of many hands and one mind"

1.8. How to improve my leadership skills?

I need to develop my abilities related to leadership under the following categories.

- Close involvement and commitment to work tasks:
  - ability to identify the critical aspects
  - ability to point out the problems clearly
  - ability to guide and encourage co-workers to the right path
- Information sharing:
  - taking self-responsibility for sharing the information on time without delays
  - expressing the authenticity of the information to others
  - understanding the needs and expectations of others
  - managing the tasks to achieve better performance outcomes

- Self-confidence, consistency on the inside, and not easily retreating
- Hardworking abilities and desire to advance
- Knowing the abilities of co-workers, especially their strengths and weaknesses
- Performing voluntarily to achieve the objectives
- Encouraging co-workers to improve their teamworking abilities
- Abilities in critical reasoning, problem-solving and decision making
- Attractiveness in routine activities
- Understanding the responsibilities related to social and environmental aspects

In addition, the following abilities will further strengthen my leadership skills.

- Observance of patience and temperance
- Identifying the speculations and motives in problematic situations
- Self-dedication and daring action
- Abilities in working without stress and frustration
- Time management skills
  (Understanding the responsibilities to complete the tasks without delays)
- Planning skills
  (Distribute the tasks to the right persons to complete the tasks on time with the required quality)

"I can be a good leader for a team. I have to improve my communication and leadership skills through my education and work experience."

"If you lead a team without proper leadership skills, it will be like monkeys capturing a car to drive"

1.9. How to improve my psychology?

I need to be aware of myself first to improve my psychological aspects. When I am aware of myself, I will get matured to improve myself towards a better life. First, I need to have the answers to the following questions.

"Who am I?"

"What are my needs?"

"What are my life goals?"

"What are my likes and dislikes?"

"What are my strengths and weaknesses?"

"Which areas that I need to be improved?"

The features of myself can be grouped into the following four categories.

1 An **open part** with features about myself that are known to me and others	**2** The **hidden part** with features about myself that are unknown to me but known to others
3 The **hidden part** with features about myself that are known to me but unknown to others	**4** The **dark part** with features about myself that are unknown to me and others

If I want to be a respectable person in society, I need to express myself to expand 'Category 1'. This will lead to improving my personality and uniqueness.

I need to follow the following good practices in my daily routines for reinforcing my psychological aspects.

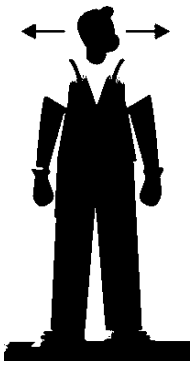
- Continuous involvement in physical exercises and meditation
- Performing with the positive mindset
- Practising healthy habits (sleeping well, taking healthy meals, avoiding the habits which are harmful to the health, reading good articles, listening to music, Gaining goodwill among the family members and friends, etc.)
- Performing with the understanding of social responsibilities and needs
- Maintaining good contacts with the trusted and educated persons and getting their useful opinions and thoughts
- Adapting the abilities to the changes of the new environment
- Keeping the same mindset in successes and failures
- Performing with the understanding of others' feelings and needs

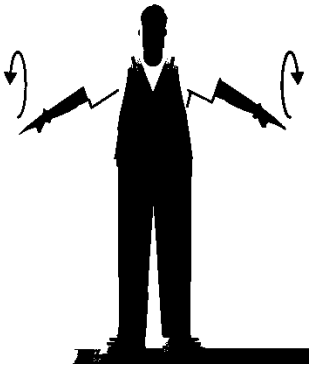
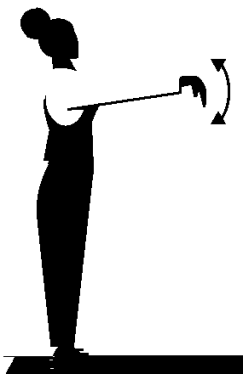
"Never make permanent decisions based on temporary feelings"

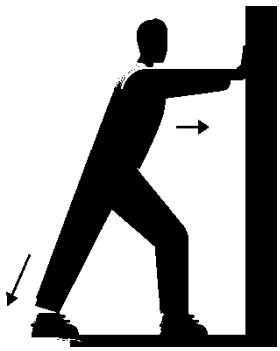
1.10. How to improve my physical ability?

It is highly beneficial for my physical fitness if I follow the following good physical practices in my daily activities at my worksite.

(Source: BigRentz Inc (2021), '8 Stretches for Construction Workers to Lower Risk of Injury', https://www.bigrentz.com/blog/stretches-for-construction-workers)

	**Side bend** 1. Start with your feet shoulder-width apart and your arms at your side. 2. Raise your right arm overhead and lean toward the left side. 3. Repeat with your left arm overhead and lean toward the right side. 4. Hold for 3-5 seconds. Repeat twice.
	**Neck stretch** 1. Begin with your head facing forward. 2. Turn your head slowly to one side so that your chin is over your shoulder. 3. Repeat this motion while slowly turning to the opposite side. 4. Repeat 5 times on each side.
	**Hamstring stretch** 1. Face forward and raise your foot on an elevated surface at least a foot high. 2. Slowly bend forward, stopping when you feel tension behind your thigh. 3. Switch legs and repeat on the other side. 4. Hold for 3-5 seconds on each side. Repeat twice.

	**Quadriceps stretch** 1. Find a sturdy surface or wall that you can hold onto for balance. 2. Grab your left ankle with your right hand so that your leg is bending behind you at the knee. 3. Switch to the right side. 4. Hold for 3-5 seconds. Repeat on each side of your body twice.
	**Shoulder circle** 1. Begin by standing up straight. 2. Slowly move your shoulders in a circular motion. 3. Move them upward, downward and backward. 4. Repeat the shoulder movements 5 times in each direction.
	**Chest and shoulder stretch** 1. Standing up straight, begin by bending both elbows at a 90-degree angle. 2. Position fingertips to face upward. 3. Squeeze your shoulder blades together and hold. 4. Hold for 3-5 seconds and repeat 5 times.
	**Wrist stretch** 1. Place your forearms horizontally with both palms facing the floor. 2. Bend both wrists downward so that fingertips are pointing toward the floor. 3. Extend both of your wrists so your fingertips now face upward. 4. Repeat 5 times.

	**Calf stretch** 1. Lean both hands against a wall with one foot in front of the other. 2. Straighten your back knee and drop your back heel to the ground. 3. Lean forward toward the wall to stretch your back calf. 4. Hold for 30-40 seconds and repeat with the other leg.

Further, I can follow the public health tips mentioned below in my daily meals (Source: US government's nutrition information portal).

- Eat a variety of vegetables, especially dark green, red, and orange vegetables (3 or more servings a day).
- Eat a variety of fruits (2 or more servings a day).
- Eat whole grains, and eliminate refined or processed carbohydrates; most of the grains in your diet should be whole grains.
- Drink fat-free or low-fat milk and eat low-fat dairy products.
- Choose from a variety of low-fat sources of protein — including eggs, beans, poultry without skin, seafood, lean meats, unsalted nuts, seeds, and soy products.
- Reduce intake of saturated fats and trans-fats (such as partially hydrogenated oil) as much as possible.
- Use vegetable oils instead of solid fats.
- Reduce daily intake of salt or sodium. Reduce to less than 1,500 mg per day, if you are older than 50 or have hypertension, diabetes or chronic kidney disease.

- Restrict or eliminate 'junk foods' that contain refined white flour, solid fats or trans fats, added sugars, and are high in sodium.
- Restrict or eliminate sodas and other sugar-added drinks that are high in calories and contain few or no nutrients.
- If you drink alcoholic beverages, do so in moderation. Drink only when it doesn't put you or anyone else at risk.

"Physical fitness is the first requisite of happiness"

1.11. If I am an alcohol/drug user or smoker, how can I reduce this habit?

I should know that using alcohol/drugs and smoking will result in many troubles in the human body, specifically the lungs, liver and nervous system. Many alcohol/drug users and smokers suffer due to cancer, depression, vision loss and sexual dysfunction.

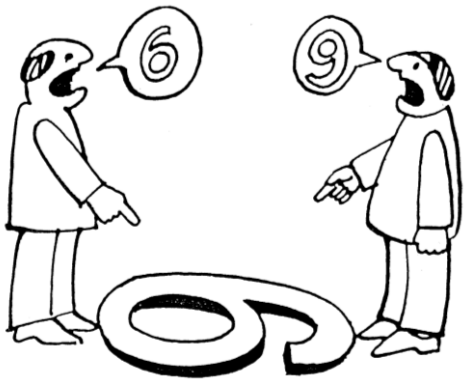
If I am an alcohol/drug user or smoker, I should try to get rid of the habit little by little. Then, I need to follow the good practices given below.

- First, I have to forget about the past. I have to believe that I can be fully relieved from this habit by following medical advice. I must first understand that nothing is impossible for me. The zeal that I will finish doing it if I think of one must come to me. I am a responsible person for the bright future of mine and my family.

"Do I realise that I'm missing out on a lot of my family's happy moments due to my selfish short-term feelings of alcohol/drug abuse and smoking?"

"If I know something is bad for me and those around me, why do I do it over and over again? Isn't it better to get rid of it immediately or gradually?"

- I can follow necessary meditation practices which may lead to result in many benefits to my health, especially increasing my self-control abilities.
- I should avoid unnecessary meetings with others who have this habit. I should try to make them too get rid of this habit resulting in many benefits to them and their families.
- I should try to involve myself and those around me in various beneficial activities for the prosperous future of mine, my family and my community. Helping others and engaging myself in community good deeds gives me satisfaction, special thoughts and beautiful experiences.



"Just because you are right, it does not mean that I am wrong. You just haven't seen life from my side"

1.12. How can I improve my self-motivation and commitment to work?

- First, I should love the work that I do.
- I should perform my work with determination and dedication, avoiding distractions and negative thoughts. It is important that I must act in accordance with the rules of the work. This may lead to overcoming my weaknesses in my job tasks too.
- I must follow time management, especially giving priority to urgent and important work.
- Performing by setting goals related to the work tasks will enhance my uniqueness as well as my work performance.
- I must understand that if I do my work with proper planning, my performance and productivity of work will increase.
- Working with others will lead me to learn many more things.

"Commitment is what transforms a promise into reality"

1.13. How can I be punctual?

If I am not punctual in my work tasks, this will result in many negative impacts on my career progress. It will signal to my employer that I have self-control problems. In addition, this will highlight that I do not value their time. It is important to

understand that nobody likes to be kept waiting. So, I must follow the good practices given below to improve my punctuality.

- First of all, I must be very clear on the benefits that I will gain by overcoming my tardiness. Adopting a habit of punctuality will help me to reduce work stress and friction with my co-workers.
- If I am not punctual, I must understand that there is a difference between the time duration that I estimate and the reality that it takes a lot longer than that.
- I must make my daily schedule realistic. If it is unrealistic, how can I possibly be on time for anything? I must make sure that I only commit to doing the number of things that I can realistically get done on time.
- Self-planning by using a timer in completing my tasks will avoid delays in my daily routine work.
- Self-preparation is one of the keys to punctuality. I should always be prepared to be on time.
- Usually, I may not like to be early because I feel that the time that I spend waiting for others is wasted time. I must understand that waiting time does not have to be wasted time. I can use the downtime as a resting time. I also can use it to meditate or think about some other interesting aspects that make me happy.

"Arriving late is a way of saying that your own time is more valuable than the time of the person who waited for you"

1.14. How can I improve my communication skills?

First of all, I need to be a good listener. I must pay attention to what others say rather than just only hear those. The following good practices will make me a good communicator at my workplace.

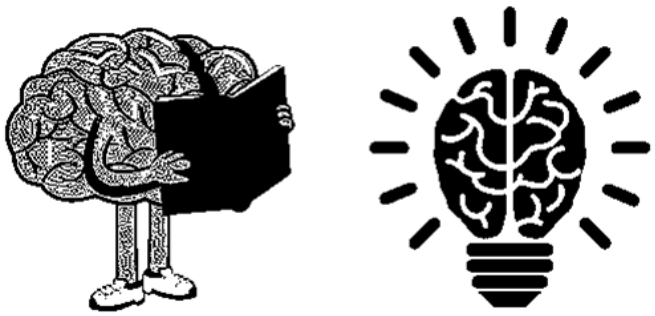
- Have good eye contact and facial expressions in my speaking.
- Think before speaking.
- Speak with confidence.
- Think about the perspective of others.
- Do not interrupt the person when he/she is speaking.
- Try to keep a smiling face while talking (Know what expression to show when).
- Do not be too loud or too slow with the tone (Know to pitch the tone effectively).
- Do not change the topic frequently, particularly when the person is taking an interest.

"Good communication is the bridge between confusion and clarity"

1.15. How can I improve my memorisation?

I can follow the good practices mentioned below to improve my memorisation.

- Eat less added sugar.
- Eat healthy nutritious foods, namely fruits, vegetables, fish, nuts, unsaturated oils (olive oil) and proteins from plant sources.
- Maintain a healthy weight.
- Follow meditation practices.
- Get enough sleep.
- Avoid excessive worries and stresses.
- Reduce alcohol usage.



"If you study to remember, you will forget,
but if you study to understand, you will remember"

1.16. How can I be an innovative thinker?

To be innovative, I need to be curious about the current and future stages of my work practices. I should ask open-ended questions to gather information and avoid placing immediate judgment about whether something will or will not work. Active listening will allow me to hear new ideas and solutions. I need to find opportunities in my day to break out of my typical routine and comfort zone. When I take risks and step away, I

can see the big picture more clearly and will be better able to find unique solutions as I am not living in what was done in the past.

"The art of questioning is to ignite innovative thinking"

1.17. How can I improve my analytical skills?

If I want to improve my analytical skills, I need to reinforce my cognitive skills. I need to develop my abilities in understanding the theories and concepts as well as their applications. When I put myself following the above-recommended practices for each question/section, my analytical skills will be improved further.

"If you have proper analytical abilities, you are very precise"

Unit 2
Science & Technology for Construction Workers

This unit helps the construction workers for improving their knowledge and skills related to science and technology that are required in the construction works. The contents included in this unit will be very useful for the construction supervisors to provide necessary work-based training exercises and conduct performance evaluations of workers towards the following elements of outcomes.

The workers will be able to

- assist in the tasks related to measurements and estimation in the construction.
- carry out construction operations with the proper understanding of construction drawing.
- use appropriate ICT applications for easy work operations.

This unit provides necessary procedures, explanations and solution guidelines that need to be followed by the construction workers for the following questions.

- How can I assist the construction supervisors / engineers in the tasks related to measurements and estimation in construction?
- How can I carry out my work with the proper understanding of construction drawing?
- How can I use appropriate ICT tools for my easy work operations?

First of all, I need to understand the importance of taking measurements and estimations. The construction elements are built mainly based on the measured/estimated values. The errors in measurements and estimations will affect the size of the constructed elements resulting in low quality, rework and other problems. So, improving my competencies in this will make me minimise errors leading to the high accuracy of my work.

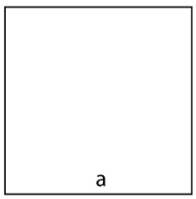
2.1. How can I assist the construction supervisors / engineers in the tasks related to measurements and estimation in construction?

First of all, I need to be familiar with the usage of the following measurement units in my work.

Measurements	Units	Conversion
Length, Width, Depth	milli metre (mm), centimetre (cm), metre (m), kilo metre (km), inches, feet (ft)	1cm = 10mm 1m = 100cm = 1000mm 1km = 1000m 1inch = 25.4mm = 2.54cm 1ft = 12inch = 0.305m
Area	square milli metre (mm^2), square centimetre (cm^2), square metre (m^2), square feet(ft^2), perch, acre	$1m^2 = 10.7639ft^2$ 1perch = 25.29m2 = $272.25ft^2$ 1acre = 160 perch = 4046.86m2
Volume	cubic metre (m^3), milli liter (ml), liter (l)	1l = 1000ml $1m^3$ = 1000l
Weight	grams (g), kilo grams (kg), tons	1kg = 1000g 1 ton = 907.18kg
Force	newton (N), kilo newton (kN)	1kN = 1000N = 101.97kg
Pressure	pascal (Pa), kilo pascal (Pa), mega pascal (MPa), newton	$1N/m^2$ = 1Pa 1kPa = 1000Pa

	per square metre (N/m^2), kilo newton per square metre (kN/m^2)	1MPa = 1000kPa
Time	seconds (sec), minutes (min), hour (h), day	1min = 60 sec 1h = 60 min 1day = 24h
Speed, Velocity	metre per second (m/s), kilo metre per hour (km/h)	1km/h = 0.278m/s
Flow rate	cubic metre per hour (m^3/h), liter per hour (l/h)	$1m^3/h$ = 1000l/h
Energy, Work	joules (J)	1J = 1Nm
Power	watt (W)	1W = 1J/s

I should use simple mathematical applications to determine the depths, areas (A) and volumes (V) in excavation and filling work.

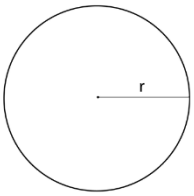


Square

$A = a^2$

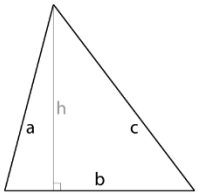
Rectangle

$A = l \times w$



Circle

$A = \pi r2$

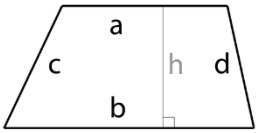


Triangle

$A = 1/2bh$

Parallelogram

$A = b \times h$

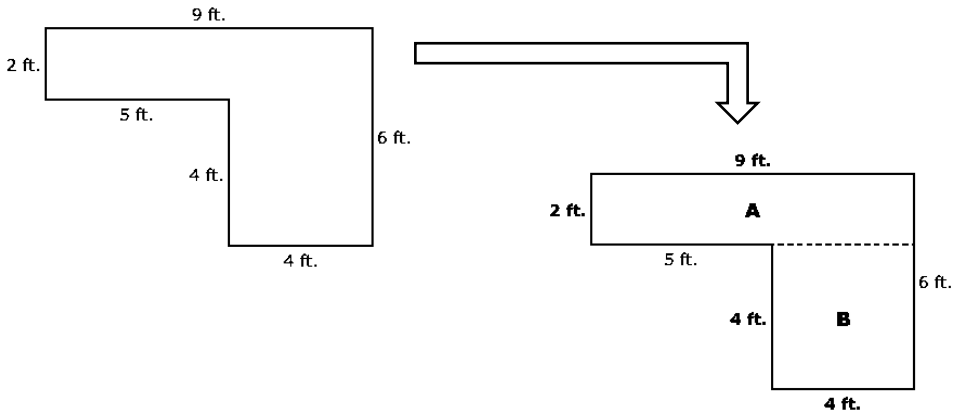


Trapezoid

$A = 1/2(a + b)h$

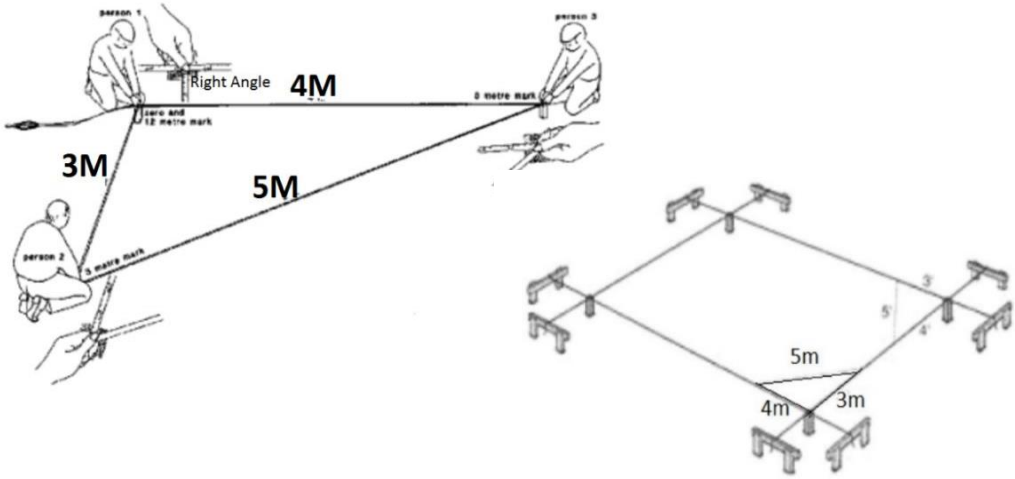
Volume = Area X Depth

For example, if I need to calculate the following excavation area, it is easy for me to calculate the total area by considering a number of rectangular parts.



Area of A = 9feet x 2 feet = 18 square feet
Area of B = 4feet x 4feet = 16 square feet
Total Area = 18 + 16 = 34 square feet

I should apply necessary mathematical concepts while performing setting out work.



- I should know how to arrange the tripods properly to fix the theodolite or levelling instruments in surveying work.

- I must know how to keep the level staff in surveying work. Importantly, I should maintain the verticality of the level staff properly.

- I must follow the right procedures to keep the surveying instruments safely after the fieldwork.

- I must know the procedures to properly arrange the instruments for performing the field density test. Importantly, I need to know how to take the depth of the holes accurately.

- I should measure the dimensions of the boards using tape for the formwork.

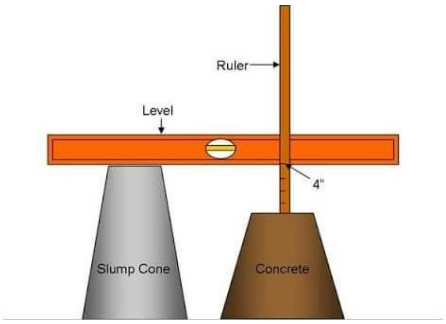
- I should know how to measure the dimensions of steel bars using tape.

- I should prepare the concrete cover blocks based on the required dimensions.

- I should make sure that the ingredients are added based on the required ratio in the concrete mix (site mixing). If I do not follow it, it will affect the strength of the construction.

- I can calculate the total volume of the ready-mix concrete considering the capacity of the concrete trucks.

- I must know the procedures to properly arrange the instruments for performing the slump test. Importantly, I need to know how to measure the slump accurately.



- I must know the procedures to properly arrange the instruments for performing the cube test. Importantly, I should give 35 blows for each 50mm layer covering the whole surface.

- I should assist to take temperature reading measurements in concreting work.

- While placing the concrete, I should check the depth of the concrete in various locations to maintain the required level.

- I should assist to measure the dimensions of sheets (polythene or polyethene) used as a damp-proof membrane in concreting work.

In road construction work,

- I should assist to take the measurements accurately using tape in clearing and grubbing work based on the estimated values.

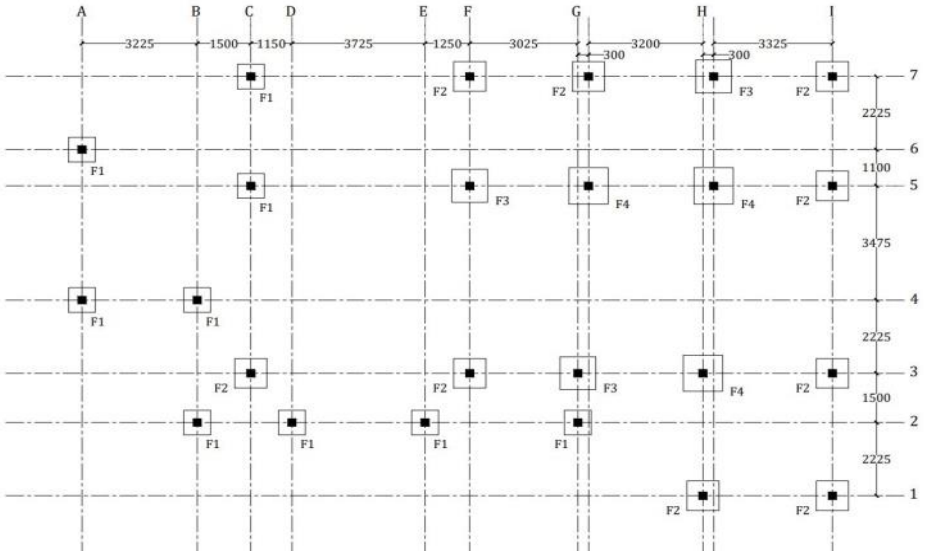
- I should assist to measure the lengths and widths using a tape for subway work based on the estimated values.

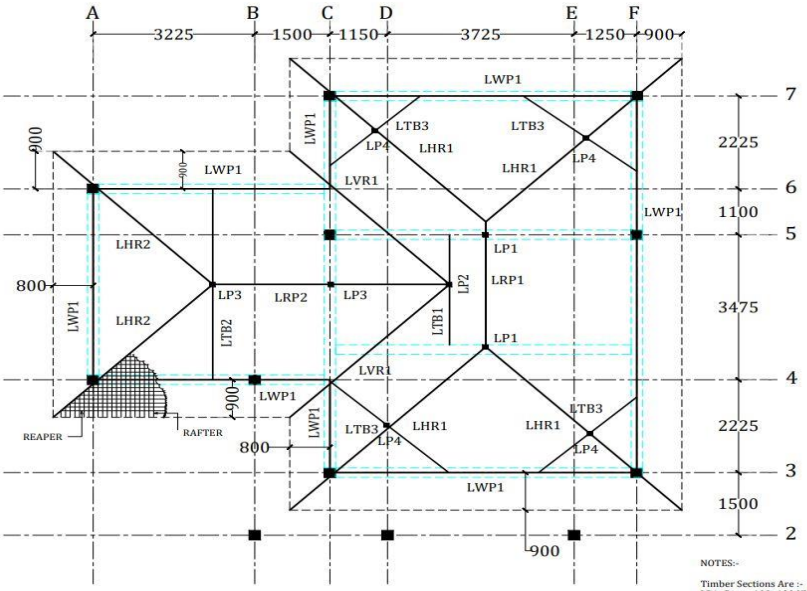
- I should assist to measure the distances for laying materials using the equipment.

- I should know how much amount of asphalt is placed on a day.
- I should assist to take temperature measurements in asphalt work.
- I should know to measure the thickness of the asphalt layer.
- I should assist to measure the lengths in road marking work.

2.2. How can I carry out my work with the proper understanding of construction drawing?

First of all, I need to be familiar with the usual notations and codes mentioned in construction drawings. Identifying different types of lines will make me easy to understand the drawing components into a number of parts.





LOWER ROOF FRAME DETAILS

NOTES:-

Timber Sections Are :-
LP1:-Post - 100x100 HW
LP2:-Post - 100x100 HW
LP3:-Post - 100x100 HW
LP3:-Post - 100x100 HW
LTB1:- Timber Beam-75x150 HW
LTB2:- Timber Beam-75x150 HW
LTB3:- Timber Beam-75x150 HW

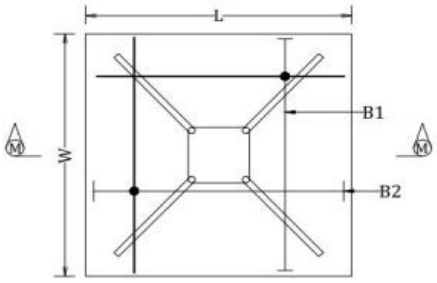
All Timber Shall be of Approved Quality.

Basic Line Types

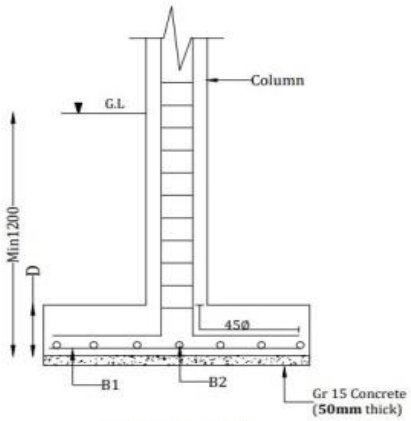
Types of Lines	Appearance	Name according to application
Continuous thick line	———	Visible line
Continuous thin line	———	Dimension line Extension line Leader line
Dash thick line	– – – –	Hidden line
Chain thin line	—·—·—	Center line

Ø - BAR DIAMETER

G.L - EXISTING GROUND LEVEL
F.F.L - FINISHED FLOOR LEVEL
F.T.L :-FOUNDATION TOP LEVEL
F.B.L :- FOUNDATION BOTTOM LEVEL
F.L :- FIRST FLOOR LEVEL
S.F.L :- SECOND FLOOR LEVEL
TH.F.L :- THIRD FLOOR LEVEL
FO.F.L :- FOURTH FLOOR LEVEL
R.B.L :- ROOF BEAM LEVEL
P.F.L :- PARKING FLOOR LEVEL
R.S.L :- ROOF SLAB LEVEL
C.P.L :- CAR PARK LEVEL
R.S.L :- ROOF SLAB LEVEL

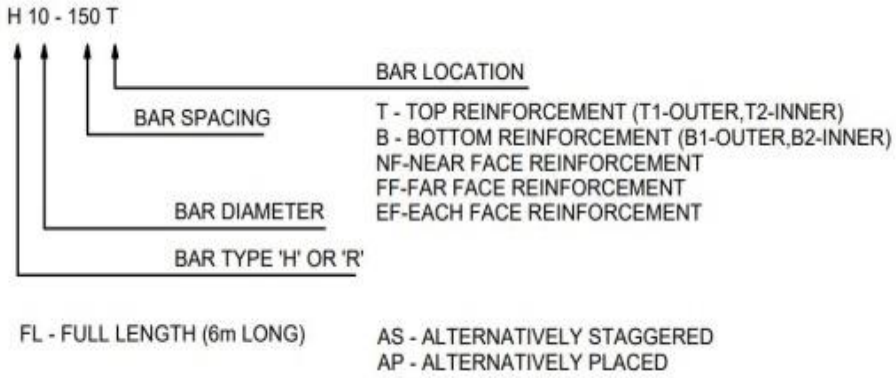


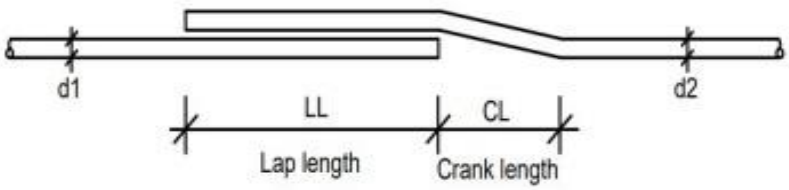
BOTTOM R/F DETAILS

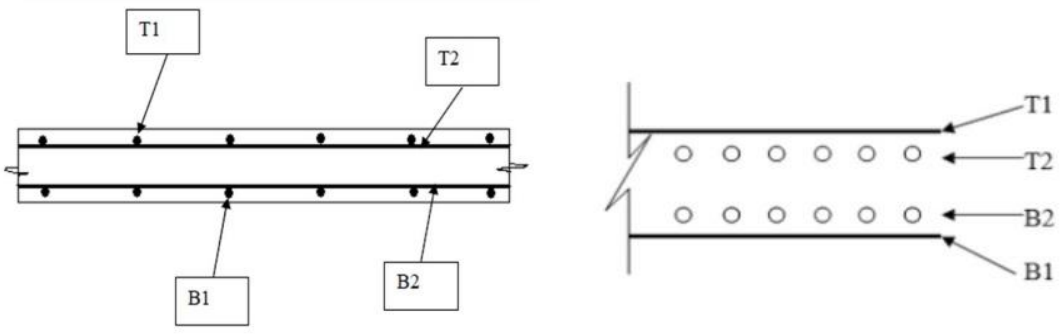


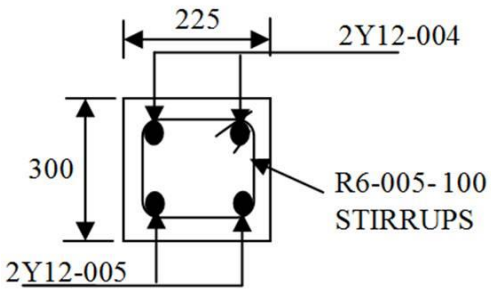
SECTION :- M - M

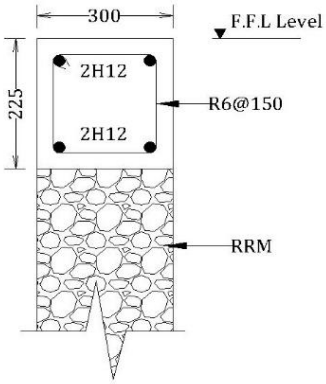
CENTRIC COLUMN FOUNDATION DETAILS					
DESCRIPTION	DIMENSIONS (mm)			RE- BARRING	
PAD FOUNDATION	L	W	D	B1	B2
F1	750	750	200	H10@150	H10@150
F2	900	900	225	H10@150	H10@150
F3	1000	1000	225	H10@150	H10@150
F4	1100	1100	250	H10@150	H10@150



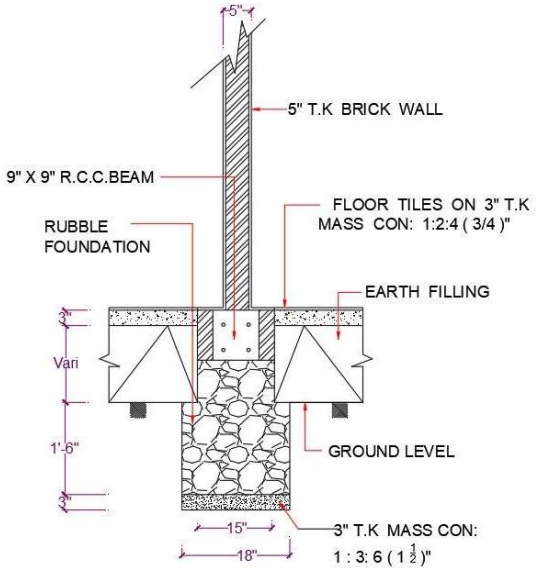


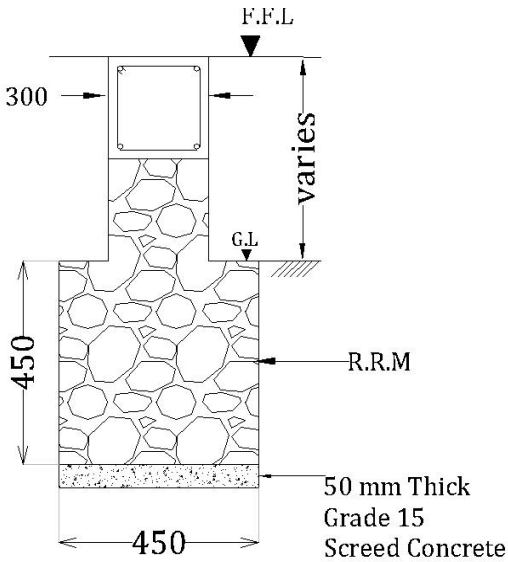




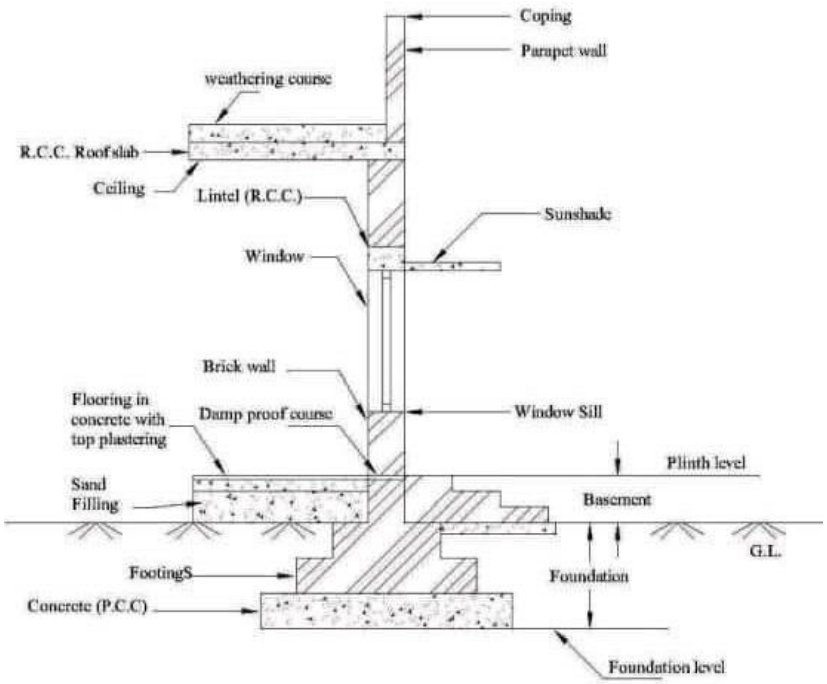


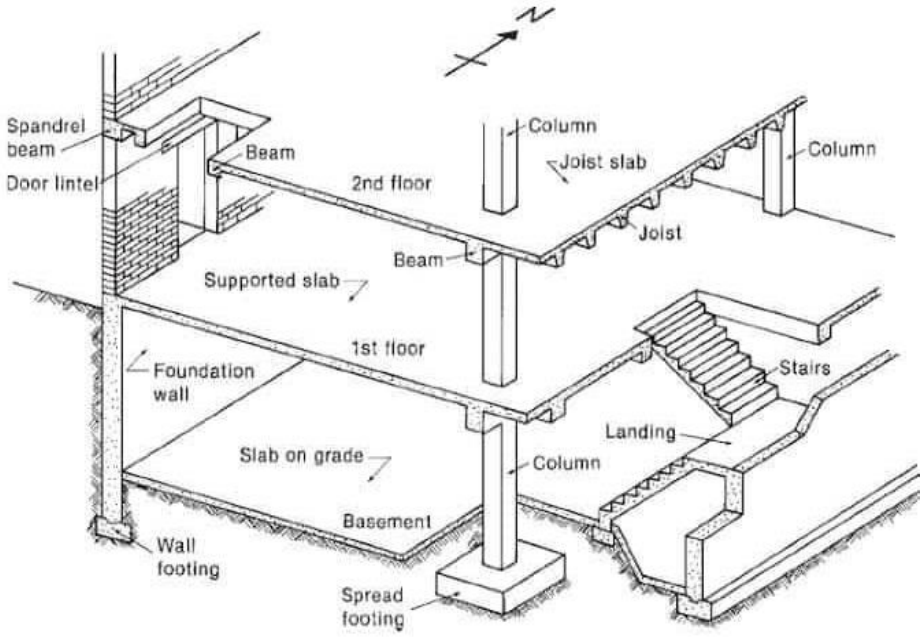
Plinth Beam

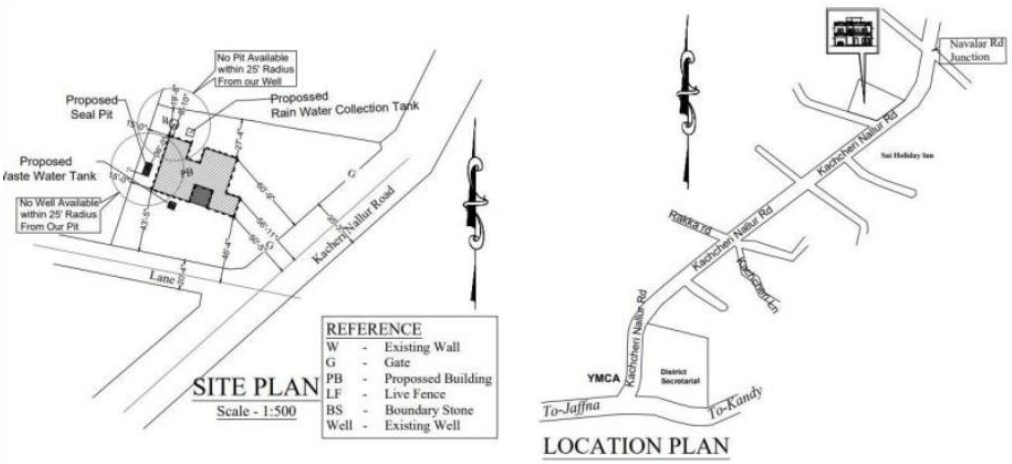




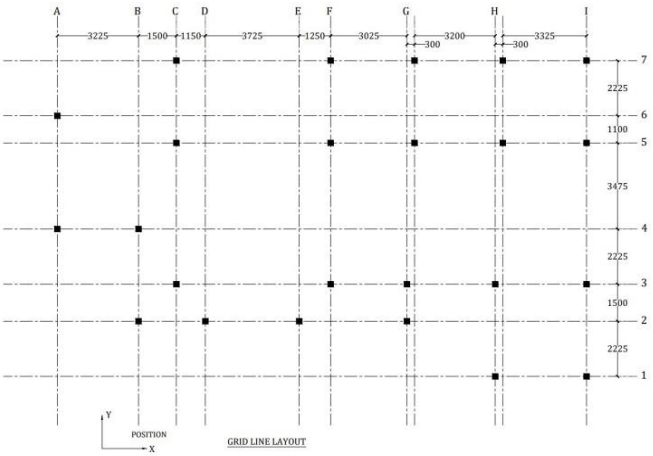
FOUNDATION DETAILS





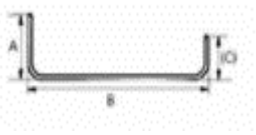


- The setting out work is importantly carried out to build the construction elements at the required locations. So, I should study the drawings before setting out works.



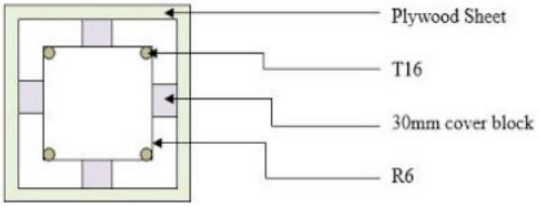
- I should carry out my tasks by understanding the lengths and slopes shown in the drawing.

- If I involve bar bending, I should make sure to bend the bars based on the dimensions mentioned in the drawings.



- I should practice myself to read and understand the bar schedule table.

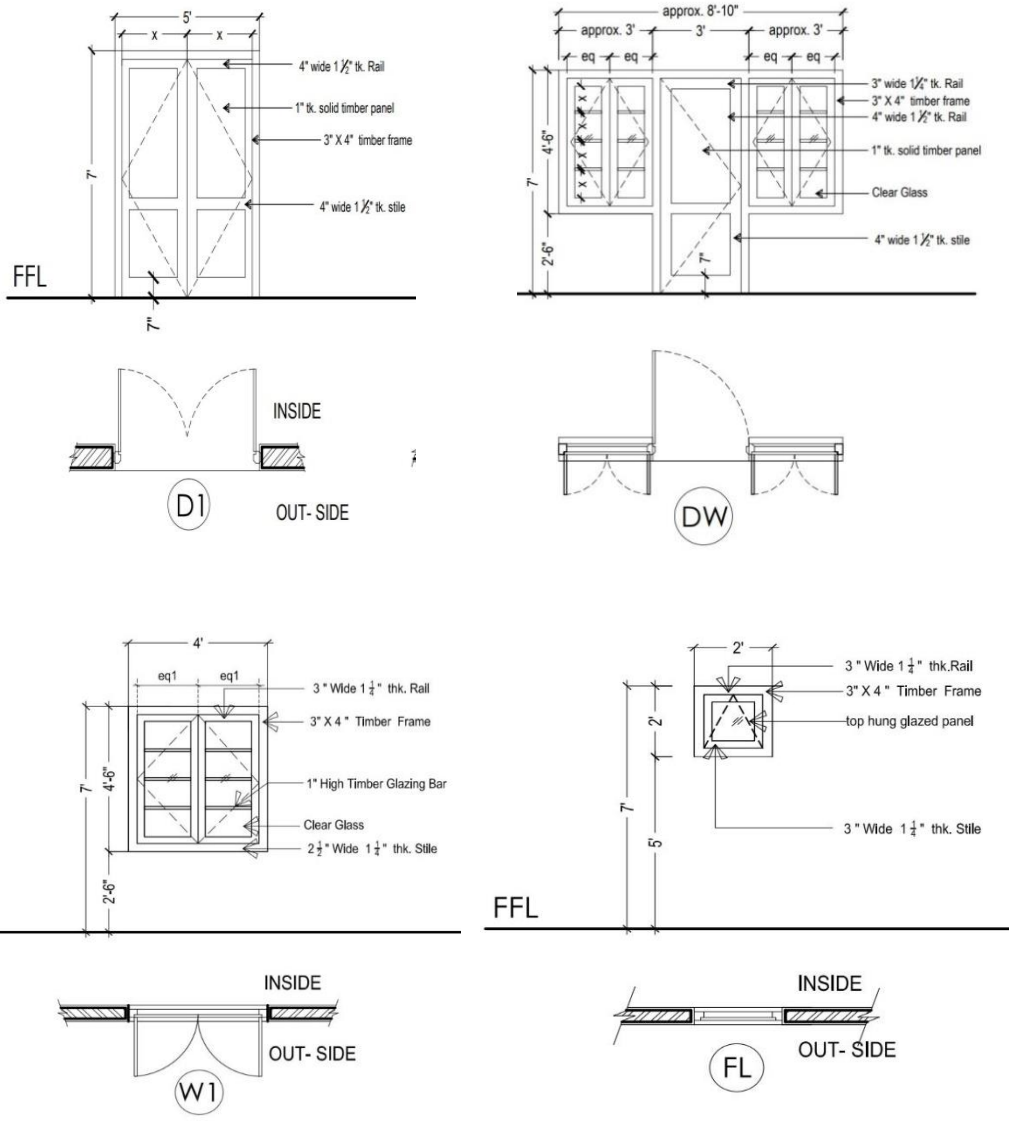
COLUMN NUMBER	SIZE BELOW F.F.L	SIZE ABOVE F.F.L	MAIN R/F	STIRRUPS	Y / X POSITION
C1 (UP TO LOWER SLAB LEVEL)	225x225	225x225	4H12	R6@125	
C2	225x225	225x225	4H16	R6@175	
C3	225x225	225x225	4H16	R6@175	
C4	225x225	225x225	4H12	R6@125	
C5	225x225	225x225	4H20	R6@200	
C6	225x225	225x225	4H20	R6@200	
C7	225x225	225x225	4H20	R6@200	
FC4	125x225 UP TO STAIRCASE FIRST LANDING		4H12	R6@125	



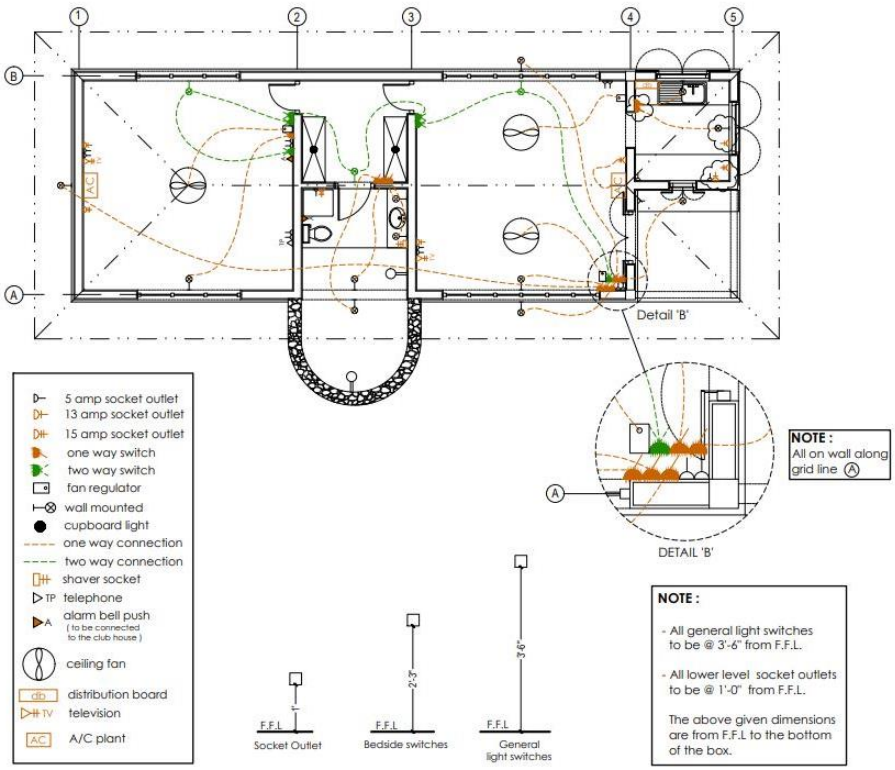
- I should do the excavation and the formwork for the drains based on the dimensions mentioned in the cross-sectional drawings. I also need to understand the flow direction in the drains based on the slopes mentioned in the drawings.

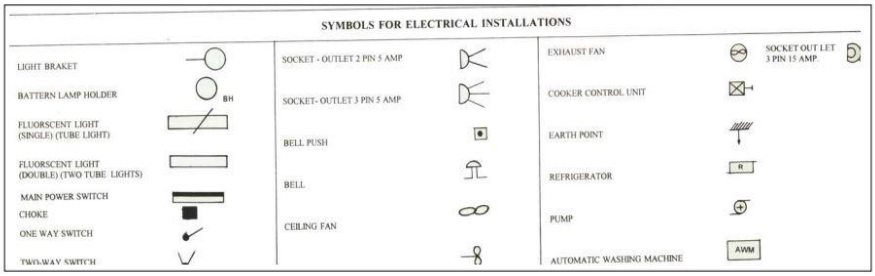
- I should place the cover blocks at the right locations based on the information provided in the drawings.

- If I involve in carpentry, I should practice myself to read and understand the drawings related to carpentry work.

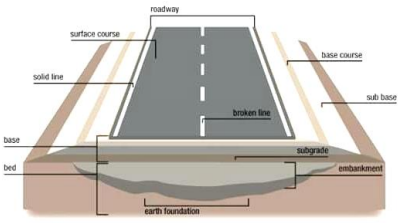


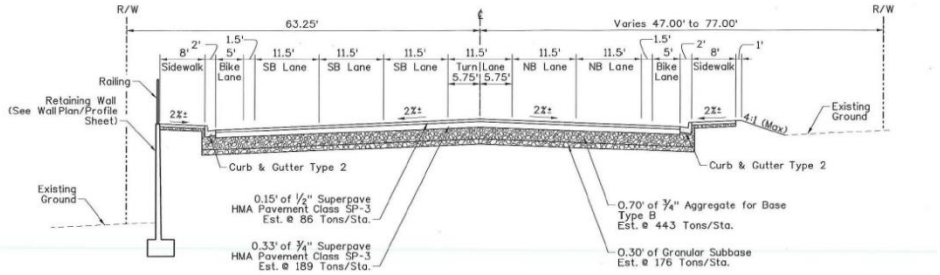
- If I involve in electrical work, I should practice myself to read and understand electrical drawings, especially understanding the lines, symbols and notations.





- If I work on road projects, I should identify the different layers in the cross-sectional drawings of a road.





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2.3. How can I use appropriate ICT tools for my easy work operations?

- If I have a smartphone, I can
  - take photos of important components in construction which may be useful for my subject learning.
  - take the photos of construction drawings for my learning and working purposes.
  - record the videos of on-site experiments and demonstrations for my learning and working purposes.
  - take photos or record videos to indicate safe or unsafe components or locations.
  - maintain daily work schedules, progress records and reminders effectively.
  - keep necessary evidence and records for future actions.

- I can use the calculators in measuring and estimating work. There are many mathematical functions that can be used in calculators to make my work easy. There are many other mobile applications available to make the work easier in various categories. I can try to use such applications to check their usability.

- I can learn software packages to create files and documents electronically.

- If I can create personal accounts on social media (WhatsApp, Viber, Facebook, etc.), I can effectively improve my communication skills. I can also be updated myself with the latest information on time.

- I can attend meetings, workshops and training using modern technological applications for my learning and working purposes.

Unit 3
Engineering & Technology for Construction Workers

This unit helps the construction workers for improving their knowledge and skills related to engineering and technology that are required in the construction works. The contents included in this unit will be very useful for the construction supervisors to provide necessary work-based training exercises and conduct performance evaluations of workers towards the following elements of outcomes.

The workers will be able to

- carry out work operations with the proper understanding of simple structural and architectural concepts.
- assist in the tasks related to flow measurements, soil testing and surveying procedures.
- use electrical sources following safety regulations.

This unit provides necessary procedures, explanations and solution guidelines that need to be followed by the construction workers for the following questions.

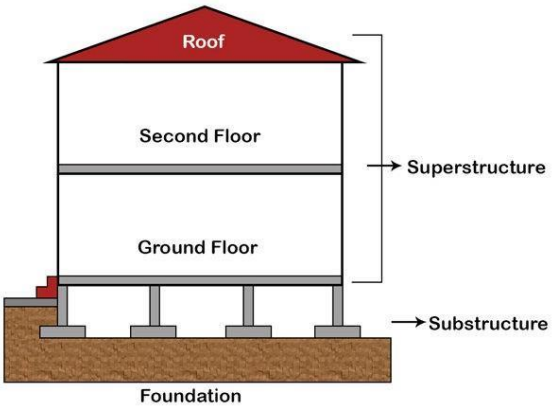
- How can I carry out my work with the proper understanding of simple structural and architectural concepts?
- How can I assist the construction supervisors / engineers in the tasks related to flow measurements?
- How can I assist the construction supervisors / engineers in the tasks related to soil testing?

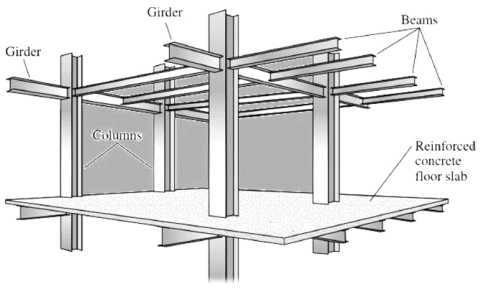
- How can I assist the construction supervisors / engineers in the surveying procedures?
- How to use electrical sources following safety regulations?

3.1 How can I carry out my work with the proper understanding of simple structural and architectural concepts?

I need to improve my knowledge in understanding simple structural and architectural concepts. So, let me try to learn the concepts discussed below.

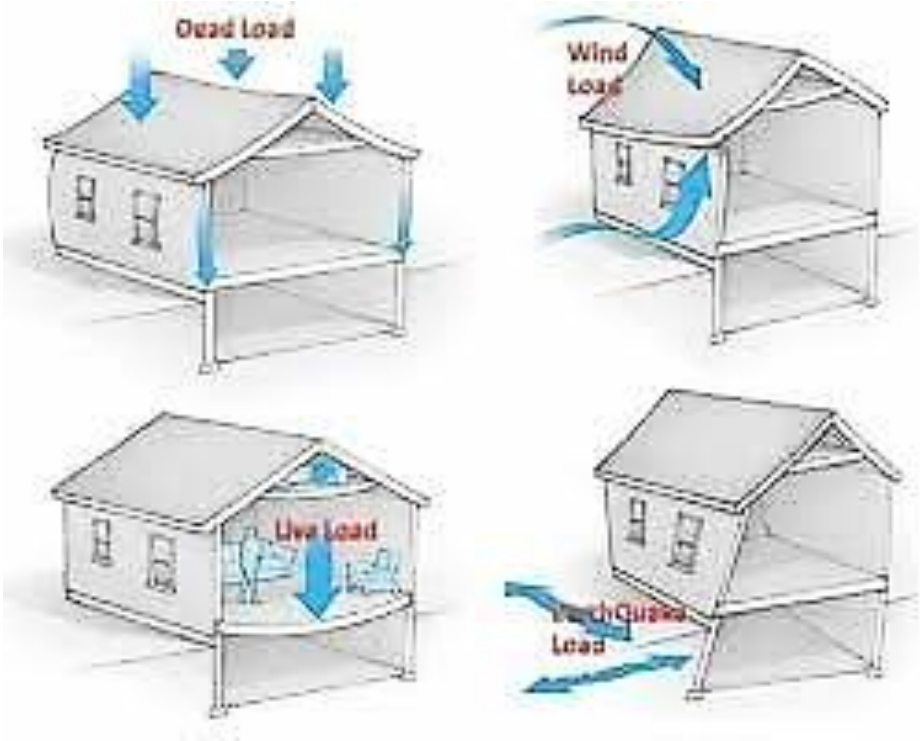
The structure of the construction can be divided into two major parts, namely substructure and superstructure. Substructure contains the structural elements below the ground level, and the superstructure included the structural elements above the ground level. Considering a building structure, I must identify the major structural elements, such as slab, beam, column and girder.



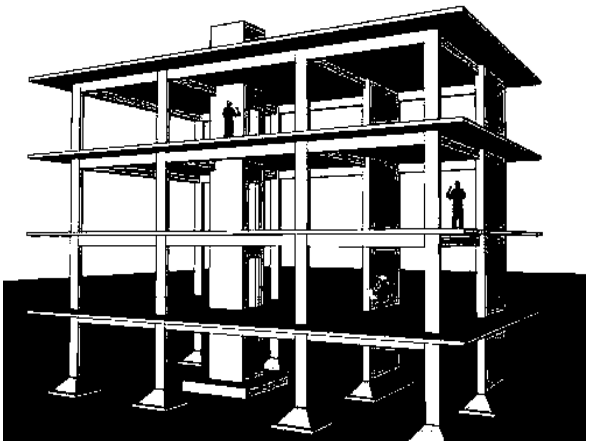


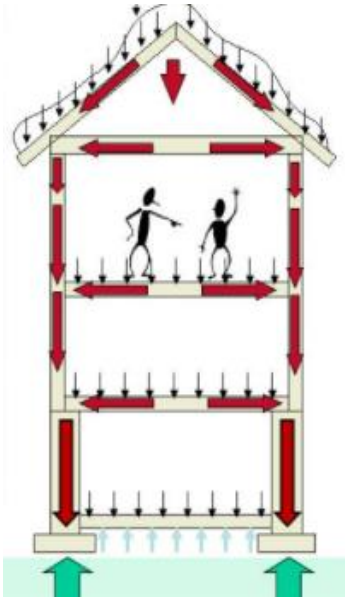
As a construction worker, I must understand the basic functions of the structural components. Before that, I need to identify the loads acting on the structure. Considering the structure of a building, the loads can be mainly categorised

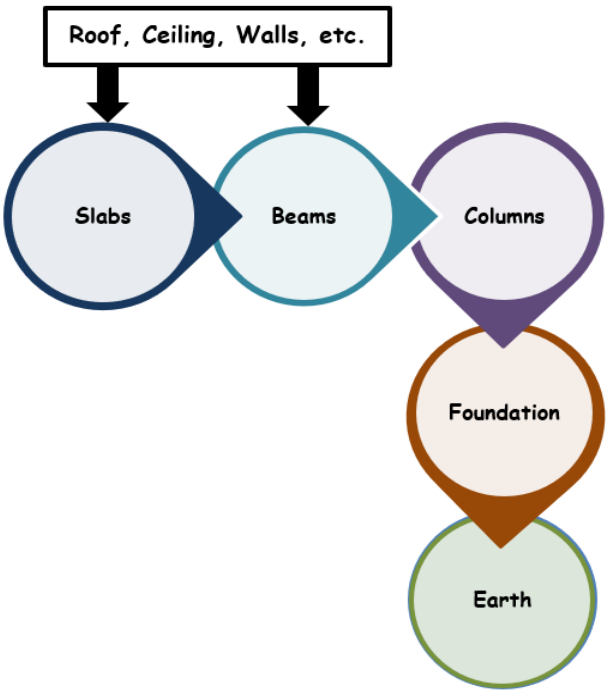
into three, which are dead loads (permanent actions), live loads (variable actions) and wind loads. The self-weight of the building components (eg. slabs, beams, columns, ceilings, walls) are the permanent actions, whereas the movable loads (eg. human, furniture, vehicle) are in the category of variable actions.



I must understand how the loads are transferred among the structural elements in a building.



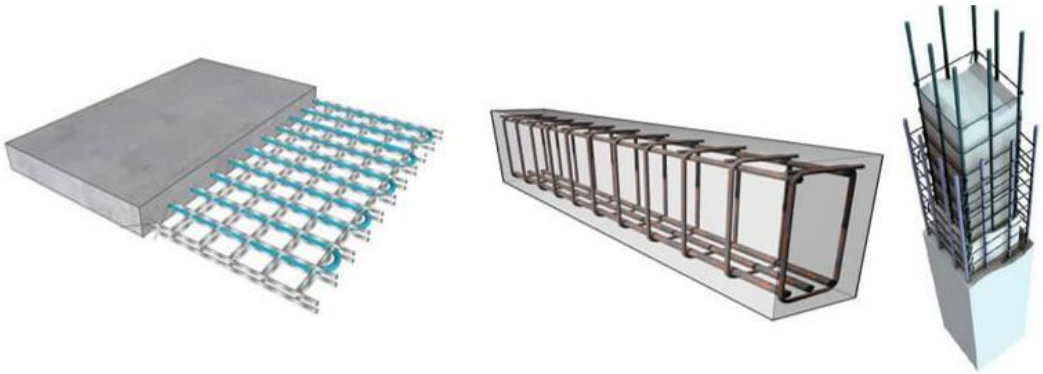




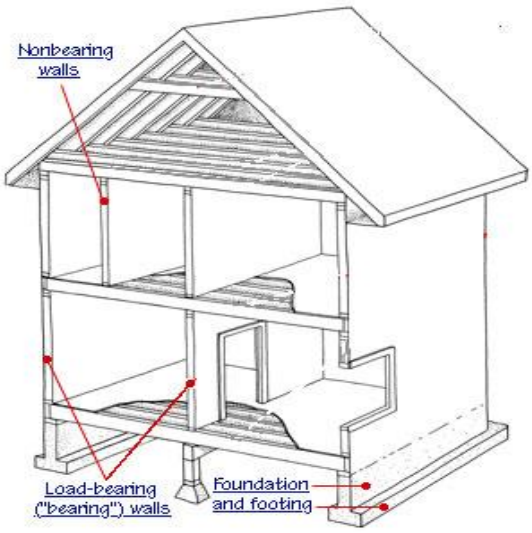
I can now easily understand that the loads are heavier in lower floor columns than in the upper floor columns. Hence, the column sizes are larger on the lower floors than on the upper floors.

I can also understand now why the foundation is generally constructed below the ground level. It transfers the whole building loads to the earth and handles the pressure exerted by the soil. There are different types of foundations available. The structural engineers decide what is the suitable type of foundation for a building by analysing the load calculations and other structural properties.

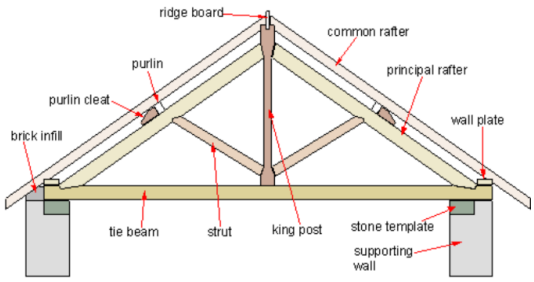
Considering the reinforced concrete building construction, slabs, beams and columns are the major loads transferring structural elements. Due to the loads applied, the internal stresses (tensile and compressive stresses) are created in these elements. The concrete material is strong in handling compressive stresses and weak in handling tensile stresses. But, the steel material can handle high tensile and compressive stresses. Hence, the steel reinforcement bars are placed in these structural elements. Generally, tore steel and mild steel are the types of steel bars used for the reinforcement. The bars with the sizes (diameter) of 10mm, 12mm, 16mm, 20mm, 25mm and 32mm are commonly used based on the structural design requirements.



Generally, the walls are constructed using bricks or blocks for partition purposes. Those can also be the load-bearing elements. They can handle low levels of stress compared to reinforced concrete structures.



I also need to identify the components of the roof structure shown in the cross-sectional view.



3.2 How can I assist the construction supervisors / engineers in the tasks related to flow measurements?

- Before I fill the tube with the water/liquid, I should make sure that there are no blockages in the tube.

- When the water/liquid is added to the tube, I should make sure that there are no air bubbles inside the tube.

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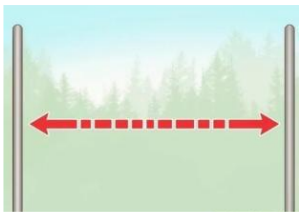
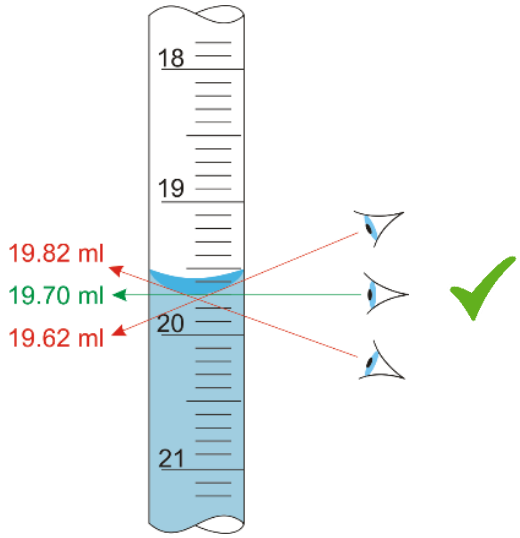
- To stir the water/liquid without leaking, I need to press the open part of the top of the tube with my thumb.

- To fix the tube with the water/liquid on a holder, I need to first check the stability of the holder.



- I should check whether the water/liquid moves both upward and downward.

- I should mark the level accurately by minimizing the parallax error. I should practice for it.



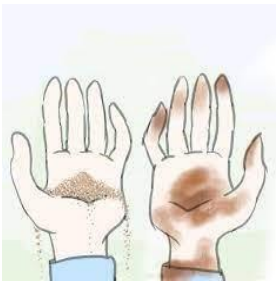
3.3 How can I assist the construction supervisors / engineers in the tasks related to soil testing?

In construction, sand is very important for many works, especially to make concrete mixes.

Before using the sand, I need to make sure that it is hard and sharp without dust, and its surface should be rough and angular.

Further, the following checks can also be done to ensure the adequate quality of the sand.

- When I take a little sand in my hand and rub it, I should feel the friction, and my hand should not be dirty.



- When I keep a little sand on a white paper for a while and remove it, the paper should not be dirty.

- I should fill half of the glass with sand and the rest with water. Then, I should shake it well and keep it rest for 2-3 minutes. If the sand quality

is adequate, the top surface of the water will be clear without turbidity.

It is beneficial to know the procedures that I need to follow for the sand cone test and moisture content test.

Sand cone test

The sand cone test is conducted to determine the density of compacted soils. This test is conducted in the field and the laboratory. The following procedures that need to be followed in the field are very important for me to help the engineer or supervisor to perform this test.

- Initially, the required area of the soil should be identified.
- The following instruments should be arranged, cleaned and brought to the field location.

A – Sand cone
B – Base plate
C – Sand of known density
D – Proctor mould
E - Trowel

- The base plate should be fixed and tightened at the required location without allowing it to move.

- Then, the soil should be extracted through the hole of the base plate up to the depth of 100-150mm.

- The extracted soil should be put inside a bag. The scattered soil also should be taken using a brush and kept inside the bag.

- The sand cone should be filled with the sand of known density. It should be weighed then. The valve should be closed to not to allow the sand to flow out.

- The sand cone should then be kept upside down on the base plate. The valve should now be opened to allow the sand to flow into the hole.

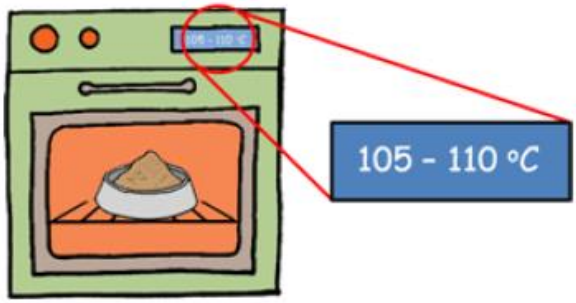
- The valve should be closed once the hole is filled with sand. Then, the instruments should be brought to the laboratory to further measurements. I need to follow the guidelines of the engineer or supervisor for further steps.

Moisture content test

This test is conducted in the laboratory to measure the percentage of moisture content in the soil. The following procedures that need to be followed in the field are very important for me to help the engineer or supervisor to perform this test.

I should hand over the wet soil sample extracted from the required location to the laboratory examiner. I should follow his instructions to measure the weights. The weighed sample with the box should be kept inside the oven for 24 hours.

The next day, I need to get out the dry soil sample from the oven, and it should be weighed. The laboratory examiner will then calculate the percentage of moisture content using the relevant formula.



In the above-mentioned experiments, if I make any errors, those may result in large changes in construction. If I do my responsibility without errors, I can proudly say that I am also a contributor to ensuring the strength of the construction.

3.4 How can I assist the construction supervisors / engineers in the surveying procedures?

First of all, I should identify the instruments which are used in surveying work.

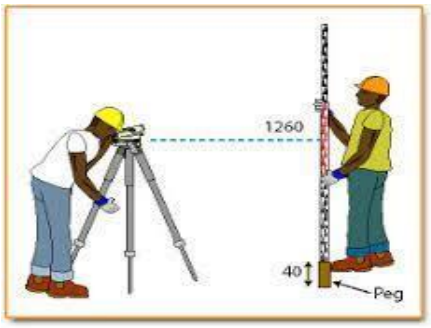
	Instrument	Uses
1.	Measuring tape 	The measuring tape is used to measure the linear short distances.
2.	Chain 	The chain is used to measure the long distances on the ground. It gives more accurate measurements compared to tape.
3.	Surveying arrows 	The surveying arrows are used to mark the chain length on the ground.
4.	Pegs 	Pegs are used to mark out the locations on the ground at terminal points or the end of the surveying line.
5.	Ranging poles 	Ranging poles are 2-3 metres in length and are painted with alternate bands of two colours (black and white or red and white or red and yellow). Each bond is kept at a length of 20 centimetres. These are used to range an intermediate point on a survey line. A flag with a suitable colour is tied at its top while carrying out longer surveys because the pole is not generally visible

		beyond 200 metres of distance.
6.	Plumb bob 	A plumb bob is used to transfer the points to the ground on a slope while chaining. It is also used to make the ranging poles vertical. In theodolites, compass and other surveying instruments, it is used for centring purposes.
7.	Cross staff 	It is the simplest instrument for setting out right angles on a survey line. It has a frame containing two pairs of opposite slits mounted on a pole. The pole can be used to fix the instrument on the ground.
8.	Prismatic compass 	It is a magnetic compass that measures the magnetic meridian. It can be either used in the palm or fixed on a tripod.
9.	Theodolite 	Theodolite is the most precise instrument for the measurement of horizontal and vertical angles. It can be used to • Measure the magnetic bearing of a line • Measure direct angles • Measure deflection angles • Extend a straight line • Establish a straight line between two points • Locating the point of intersection between two straight lines • Setting out a horizontal angle • Setting out an angle by repetition • Measuring the difference in

		elevation • Setting out curves
10.	Total station 	The total station is an electronic transit theodolite with an electronic distance meter. It is used to take the measurement of horizontal angles, vertical angles and slope distance.
11.	Levelling instrument 	The levelling instrument is used to measure the elevation differences between the locations.
12.	Levelling staff 	The levelling staff is a straight rod with graduation marks staring zero from the bottom. It is used to determine how much above or below is the station from the line of sight.
13.	Spirit level 	Spirit level is used to check the horizontality and verticality of a surface.
14.	Tripod 	Tripod is used to fix theodolite or levelling instrument rigidly at the required point for taking the measurements.

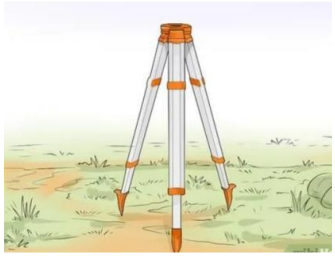
How can I assist to engineer / surveyor / technical officer in levelling work?

The levelling work is done to measure the elevation differences of locations.



If I can involve in the process of levelling the instrument, it will be very helpful for my engineer / surveyor / technical officer. I need to follow the following steps.

- I should fix the tripod to keep the levelling instrument at the right location.



- The levelling instrument can be fixed at the top of the tripod and the level can be checked using the screws.

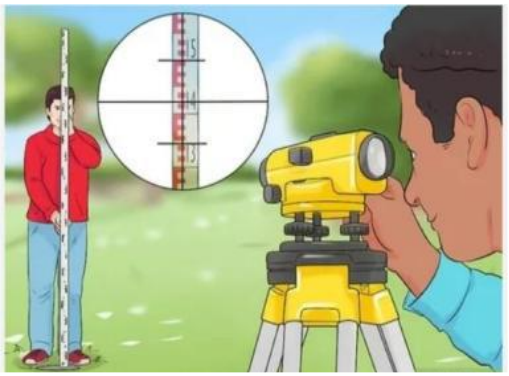
- Once the instrument is fixed on the tripod, by placing the telescope parallel to either of the two-foot screws and holding the barefoot screws with the thumb and forefinger, the bubble can be tilted to the centre to make sure the instrument is levelled.

- Now, the telescope should be rotated by 90°. After that, the bubble should be tilted to the centre using the third foot screw.

- Then, the telescope should be rotated to the initial position. Now, the bubble should be at the centre. If not, the previous steps should be repeated.

- At last, the telescope should be rotated by 180°. If the bubble is at the centre now, it confirms that the instrument is completely levelled.

When I keep the levelling staff, the verticality must be importantly maintained. I can keep it between my heel and toes. If I do not do it properly, there will be some errors in the measurement resulting in major changes in construction.



I need to be responsible for the safety of the surveying instruments. I should understand that these instruments are very expensive.

Before keeping the levelling instrument or theodolite in the box, I should make sure that all the clamps are released. In addition, I need to check whether the lenses are wet. If so, I need to keep it dry before putting it into the box.

3.5 How to use electrical sources following safety regulations?

When I work with electrical sources, I need to follow the following rules to ensure safety.

- Treat all electrical devices as if they are live or energised.
- Disconnect the power source before servicing or repairing electrical equipment.
- Use only tools and equipment with non-conducting handles when working on electrical devices.
- Never use metallic pencils or rulers, or wear rings or metal watchbands when working with electrical equipment.
- When it is necessary to handle equipment that is plugged in, be sure your hands are dry and, wear nonconductive gloves, protective clothes and shoes with insulated soles.

- Minimise the use of electrical equipment in the areas where condensation is likely. If equipment must be used in such areas, mount the equipment on a wall or vertical panel.
- If water or a chemical is spilt onto equipment, shut off power at the main switch or circuit breaker and unplug the equipment.
- If an individual comes in contact with a live electrical conductor, do not touch the equipment, cord or person. Disconnect the power source from the circuit breaker or pull out the plug using a leather belt.
- Do not rely on grounding to mask a defective circuit nor attempt to correct a fault by insertion of another fuse or breaker, particularly one of larger capacity.
- Drain capacitors before working near them and keep the short circuit on the terminals during the work to prevent electrical shock.
- Never touch another person's equipment or electrical control devices unless instructed to do so.
- Enclose all electric contacts and conductors so that no one can accidentally come into contact with them.
- Never handle electrical equipment when hands, feet, or body are wet or perspiring, or when standing on a wet floor.
- Do not store highly flammable liquids near electrical equipment.
- Do not wear loose clothing or ties near electrical equipment.

Unit 4
Technologies and Methods Used in Construction Works

This unit helps the construction workers for improving their knowledge and skills in technologies used for various types of construction works. The contents included in this unit will be very useful for the construction supervisors to provide necessary work-based training exercises and conduct performance evaluations of workers towards the following elements of outcomes.

The workers will be able to

- follow health and safety guidelines in all types of construction works at the job site.
- carry out work operations with the proper cognitive and manual skills in technologies used for construction works.
- handle the equipment properly in machinery operations at the construction site.

This unit provides necessary procedures, explanations and solution guidelines that need to be followed by the construction workers for the following questions.

- What are the guidelines and procedures related to health and safety that need to be followed in my work at the construction site?
- How to improve my cognitive and manual skills in the technologies used for the construction works?
- How to handle the equipment properly in machinery operation?

4.1. What are the guidelines and procedures related to health and safety that need to be followed in my work at the construction site?

I must follow the following good practices at my worksite.

- Wearing safety equipment at all times

- Keeping the worksite neat and clean
- Not involved in any works without proper instructions
- Not trying to do dangerous and unfamiliar work
- Following the safety signals for all times
- Reporting about any identified unsafe areas to my construction supervisors
- Removing the broken and damaged items properly from the work areas
- While doing the scaffolding work, make sure that
    - the crossbeams are properly connected.
    - any bars are not rusty.
    - the ladder and deck are properly fixed.

- While working at heights, make sure that the warning tapes are available in the right areas and visible to everyone.
- While working with the hoist, make sure that
    - no damages are in hoist cables.
    - electrical connections are properly working.
    - the loads are under the capacity level of the hoist.
- While working on roads at night, use light colour wears to reduce the chances of accidents.
- Keep the safety notices and signals visible to everyone at the right locations.

- Make sure the availability of first aid facilities at the worksite.

- Make sure that
    - drinking water quality is good at the worksite.
    - taking healthy foods at the worksite (a large amount of energy is needed to perform the tasks well).
    - Washing and sanitary facilities are good.
- Considering the actions against spreading diseases like Covid 19 pandemic, strictly following relevant health regulations, especially wearing masks, washing hands regularly and maintaining social distance.

"Occupational health and safety is vital to the dignity of work"

"Safety regulations are the effective and cheap insurance policies"

4.2. How to improve my cognitive and manual skills in the technologies used for the construction works?

In the land clearing, excavation, filling and compaction processes,

I need to be familiar with the equipment operations at the worksite.

Excavator:

Excavator is popular earthmoving equipment that features a bucket, arm, rotating cab, and movable tracks. These components provide digging power and mobility to perform a variety of functions, such as digging trenches and breaking holes lifting away waste and excavating mines.

Dozers:

Dozers are used for shallow digging and ditching, short-range transportation of material, spreading soil dumped from trucks, rough grading, removing trees, stumps and boulders, and cleaning and levelling around loading equipment.

Wheel loader:

Wheel loader is used to scoop material into trucks and transport it around a job site. It can lift rubble, gravel, soil, debris and dirt.

Dump truck:

A dump truck is used for transporting materials (such as dirt, gravel and demolition waste) for construction purposes.

Motor grader:

The motor grader is used for making smoother surfaces, levelling soil and shifting small amounts of dirt. This is commonly used to prepare the topmost layer for laying asphalt on top of it in the construction of roads.

Road roller:

A road roller is used to compact soil, gravel, concrete and asphalt in the construction of roads and foundations.

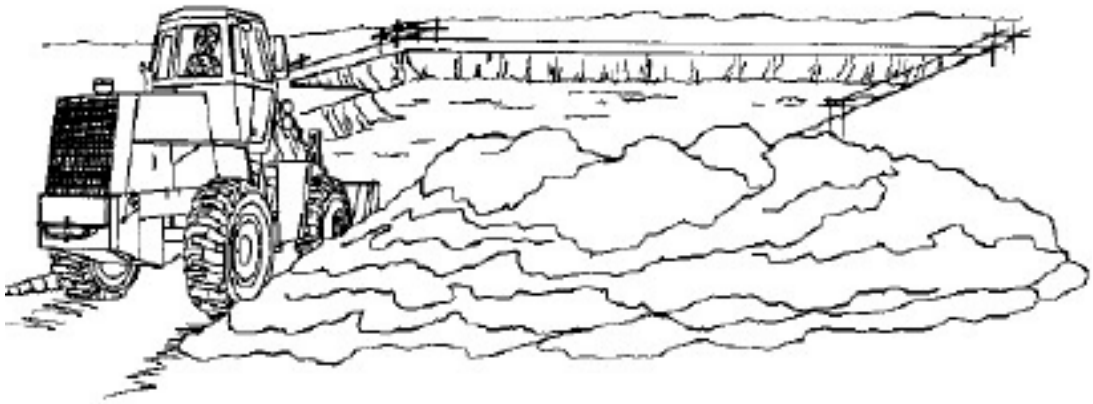
Wacker plate:

Wacker plate is used to create a level and compact sub-base before laying further materials such as tarmac, paving or asphalt. It is comprised of a vibrating plate with a motor on top and is fitted with important safety features.

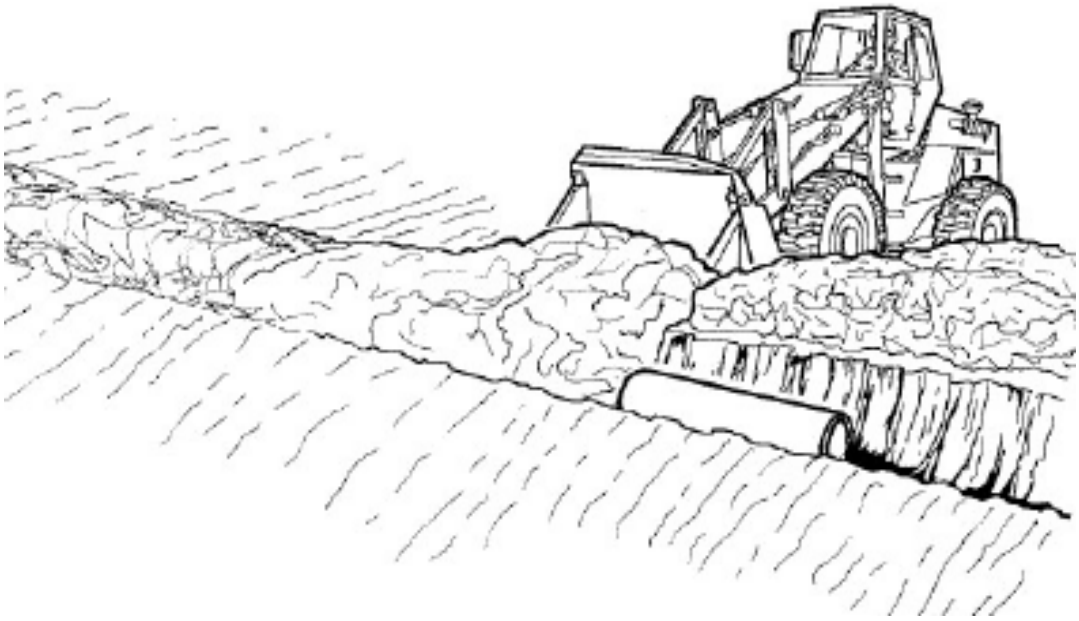
Water pump:

The water pump is used to increase the pressure of water to move it from one location to another. It is used to supply water for municipal, industrial, agricultural and residential uses. It is also used to move wastewater in sewage treatment plants.

I need to understand the directions of the work operations when the above-mentioned equipment is in the work process.

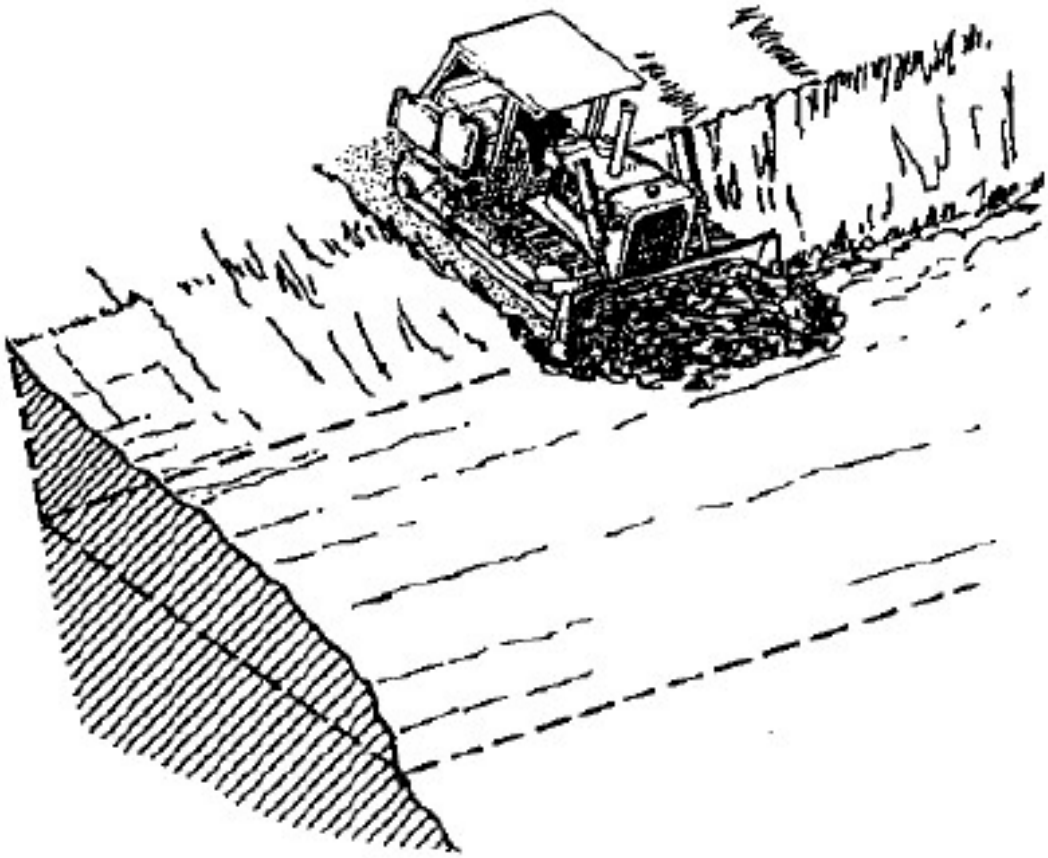


Excavations

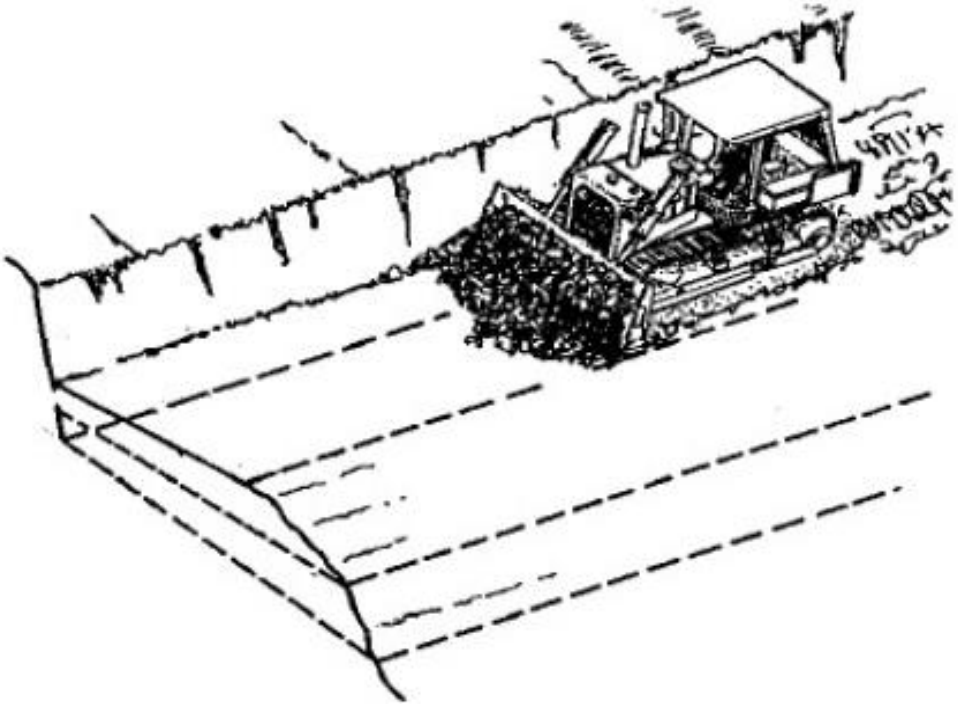


Back filling trenches

Levelling the ground

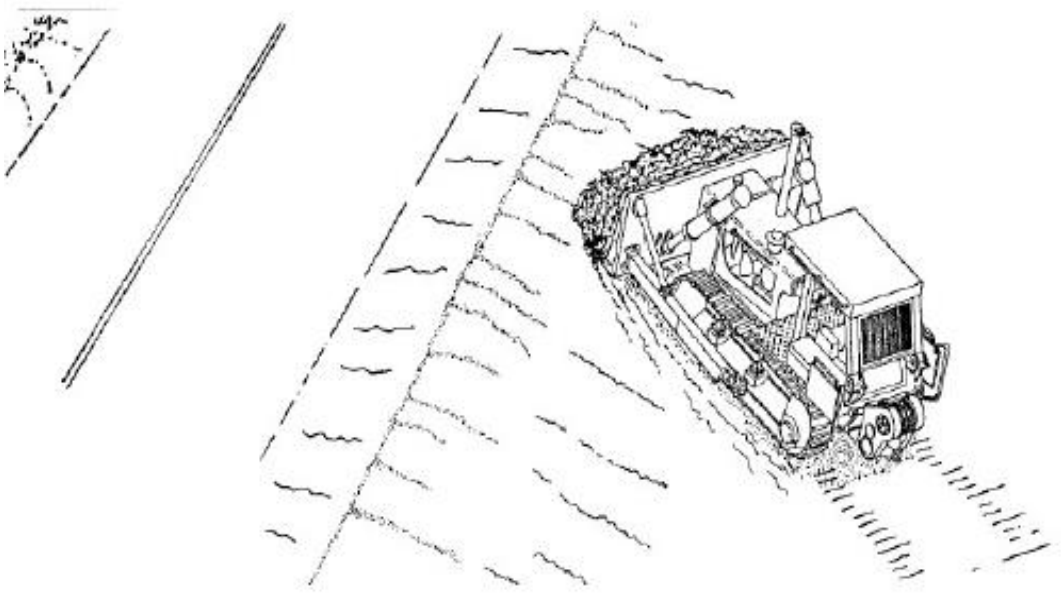


Working perpendicular to the long direction

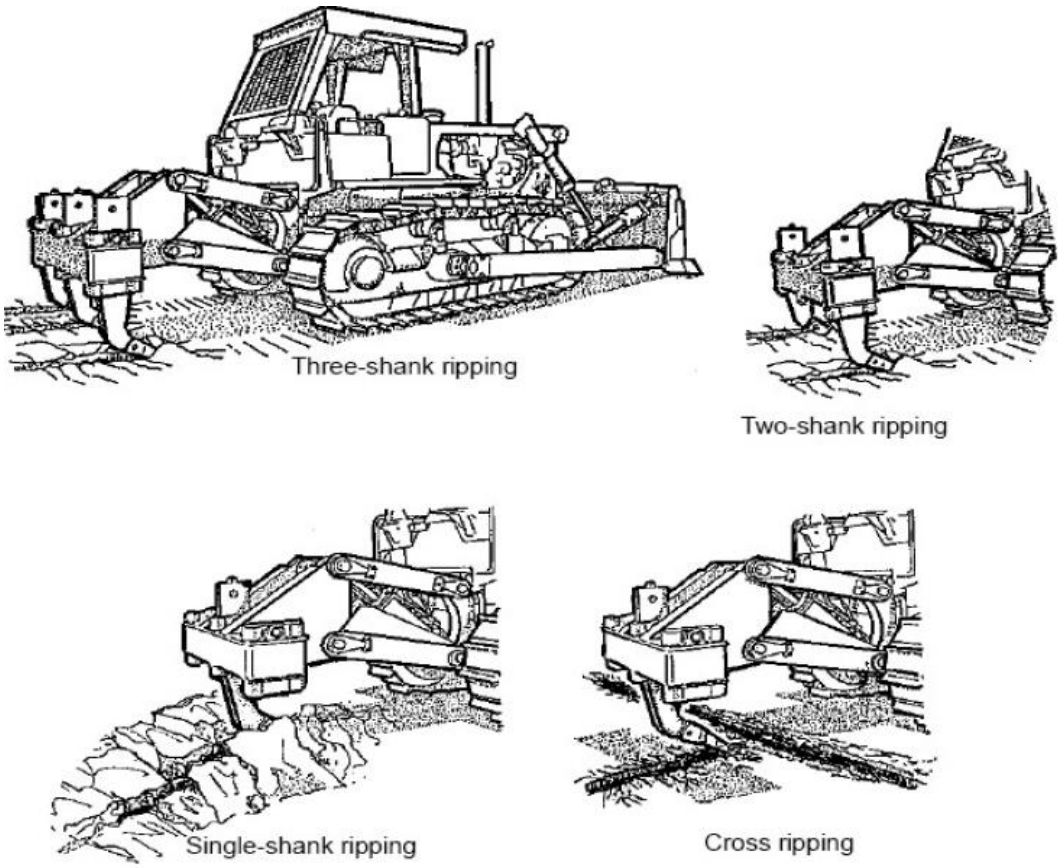


Working parallel to the long direction

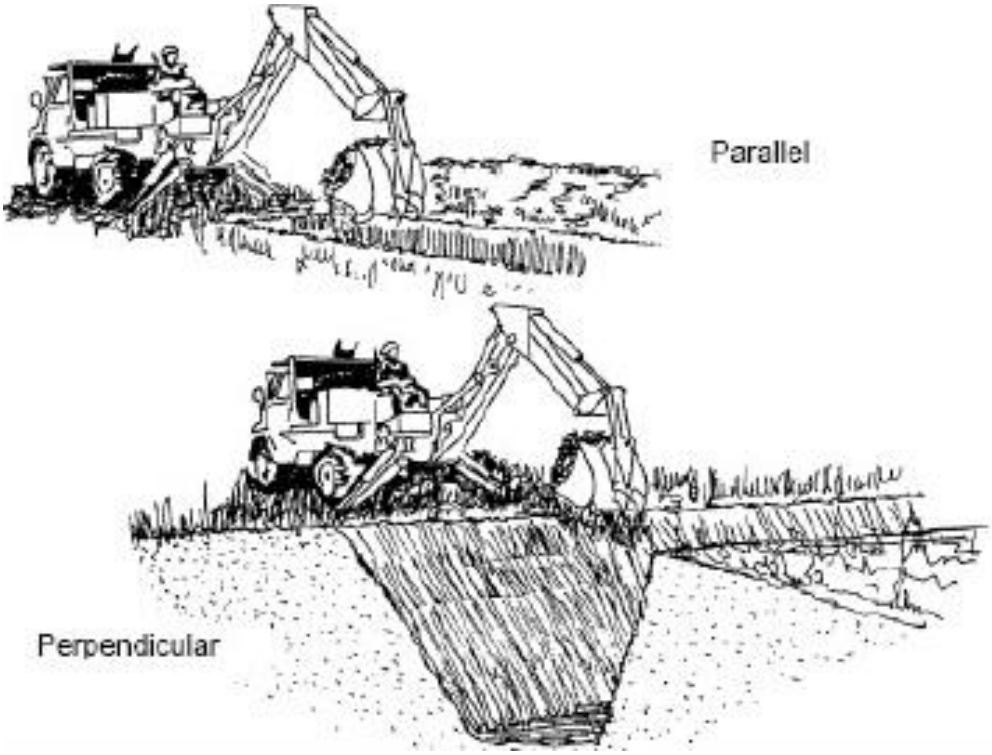
Working perpendicular to the slope



Working diagonally up to the slope



Ripping operations



Digging trenches

If my organisation arranges a suitable equipment training programme for the above operations, it will be very useful for me.

In road construction projects,

I need to have a basic understanding knowledge on the following processes and their purposes.

Sub-base laying:

The sub-base is the main load-bearing layer of paving construction. It spreads a load of traffic, whether pedestrian or vehicle, down to the sub-grade.

ABC (Aggregate Base Course) laying:

ABC is commonly used as a road material for the construction of road bases. ABC is a mixture of various sizes of aggregates and quarry dust. The motor grader is commonly used to laying ABC.

Asphalt paving:

Asphalt is a mixture of aggregates, binder and filler, used for constructing and maintaining roads, parking areas, railway tracks, ports, airport runways, bicycle lanes and sidewalks. Aggregates used for asphalt mixtures could be crushed rock, sand, gravel or slags. The asphalt layers are used both in reinforcement operations and in the construction of new reinforcements for medium and heavy traffic. In base layers, they tend to exhibit a greater capacity for absorbing tensions. In general, they also have better fatigue resistance.

Concrete roads vs Asphalt roads:

Concrete roads are highly durable and more environmentally friendly as compared to asphalt roads. However, asphalt paving costs far less than concrete paving. Further, asphalt road provides a little better safety of the vehicle against snow and skidding.

Culverts:

Culverts are constructed under roadways or railways to provide cross drainage or to take electrical or other cables from one side to the other. The design of the culvert is based on hydraulic, water surface elevation, roadway height and other conditions.

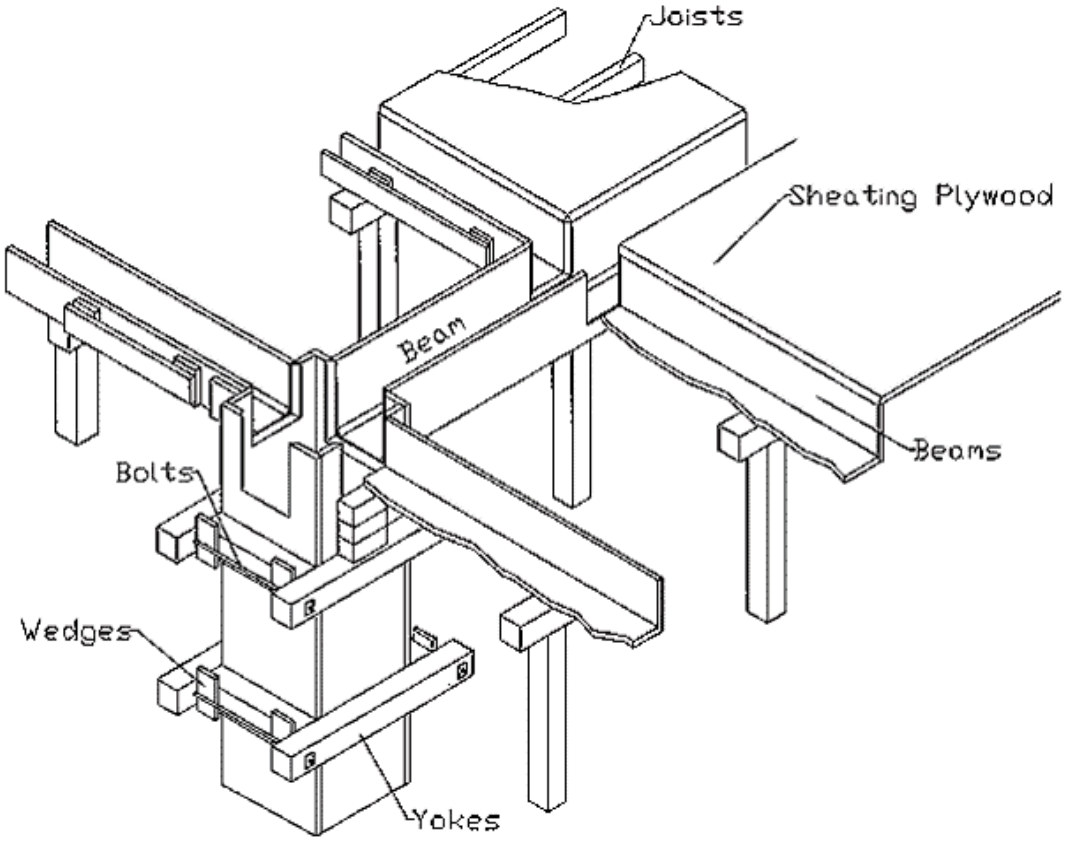
Retaining wall:

The retaining wall serves to keep soil in place. This mostly applies to landscapes featuring small hills where this acts as a necessary barrier to prevent the soil from sliding forward in a landslide.

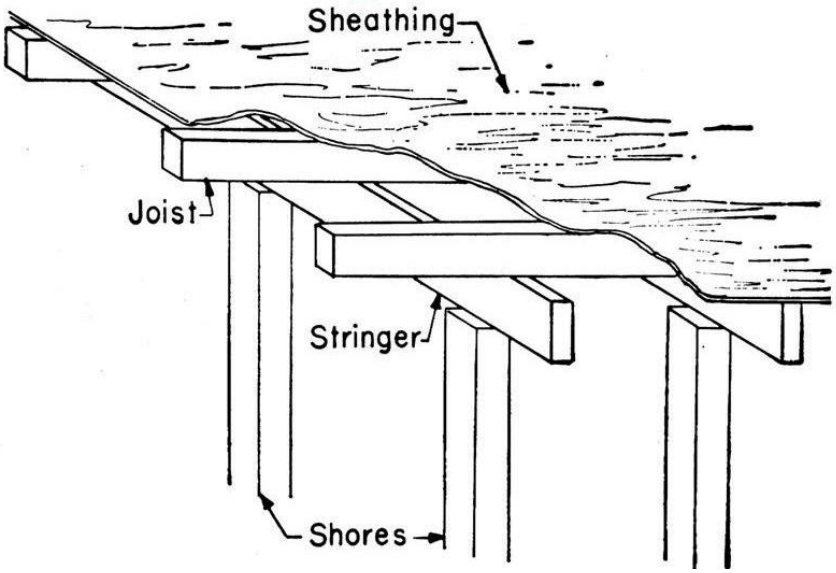
In formwork process,

I need to understand what are the components of the formwork (shuttering work) and how those are arranged/connected typically.

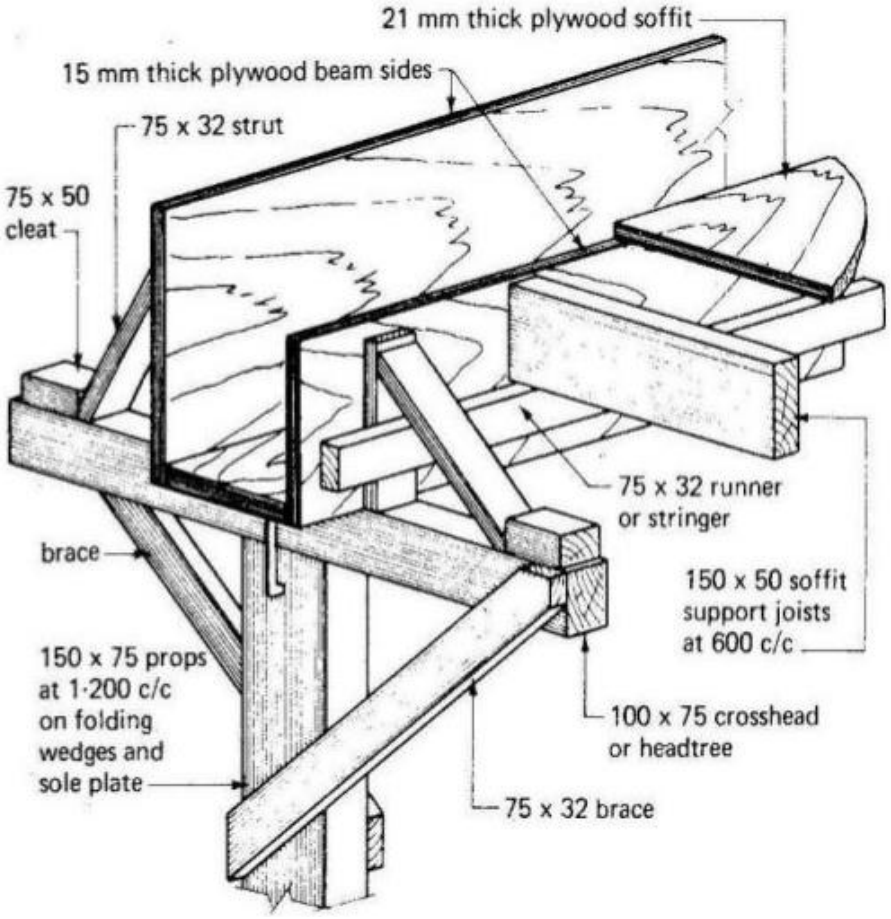
- Though several types of formworks are available in construction, timber formwork is used by most of the construction firms in developing countries.



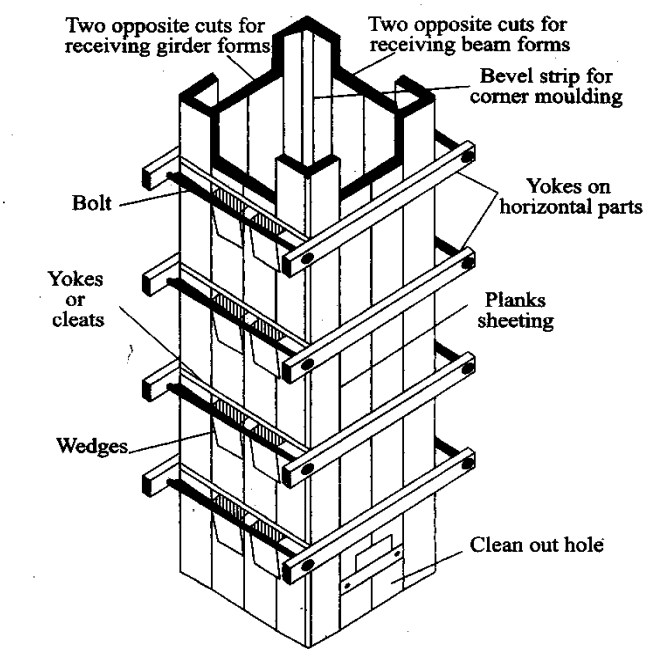
A typical formwork arrangement for a building



A typical slab formwork



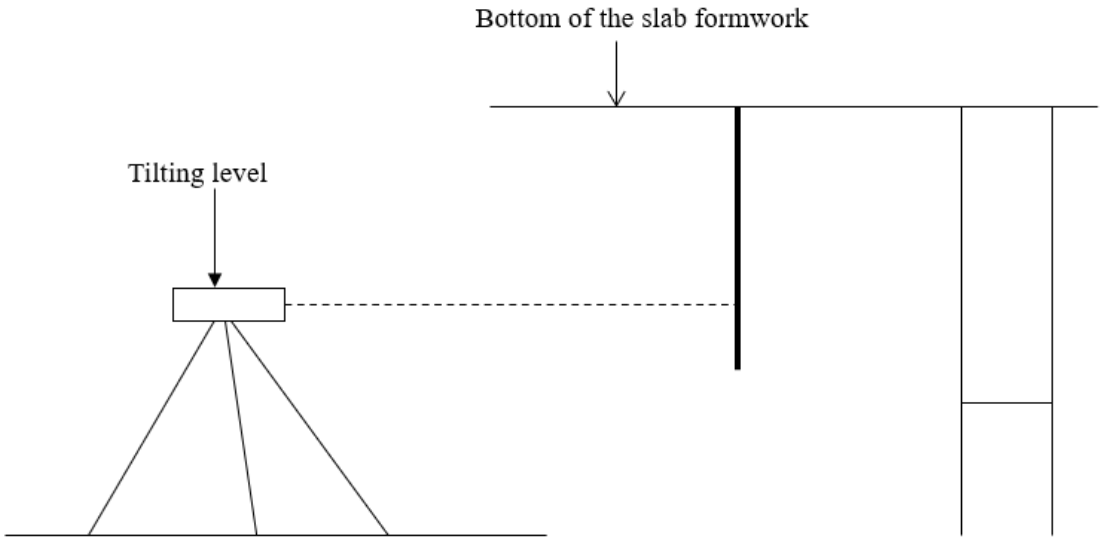
A typical beam formwork



A typical column formwork

I need to make the formwork with maintaining the required levels of each formwork component, especially the verticality and horizontality. I can check these using the spirit level.

The engineer or technical officer may also check the levels of the formwork components using the surveying instruments.



The formwork should be removed without causing any damage to concrete surfaces due to shock or vibration. Removal of formwork can be done according to the site conditions such as temperature, type of admixture used, etc.

Formwork type	Period
Vertical sides of beams, walls and columns	1-2 days
Slabs (props left in place)	4 days
Beam soffits (bottom) (props left in place)	7days
Props to slabs a) Slabs spanning up to 4.5m b) Slabs spanning over 4.5m	a) 7 days b) 14 days
Props to beams and arches a) Spanning up to 6m b) Spanning over 6m	a) 14 days b) 21 days

Steel reinforcement

I should first try to read the bar notations and understand the reinforcement details. For example,

12T12-60-150T1

12 – Number of bars
T – Type of bar [R- Mild steel, T-Tore steel]
12 – Diameter of the bar in mm
60 – Bar mark
150 – Spacing between bars in mm [centre to centre]
T – Identification of layer [top or bottom]
1 – Position of layer [outer or inner]

I should then practice reading and understanding the bar schedule table. A standard bar schedule consists of the details about the number of bars, bar mark, bar types, diameter, weights and lengths of bars and their shapes. I need to cut and

arrange the bars based on the details mentioned in the bar schedule, and this will reduce the bar cutting wastages.

A sample bar schedule

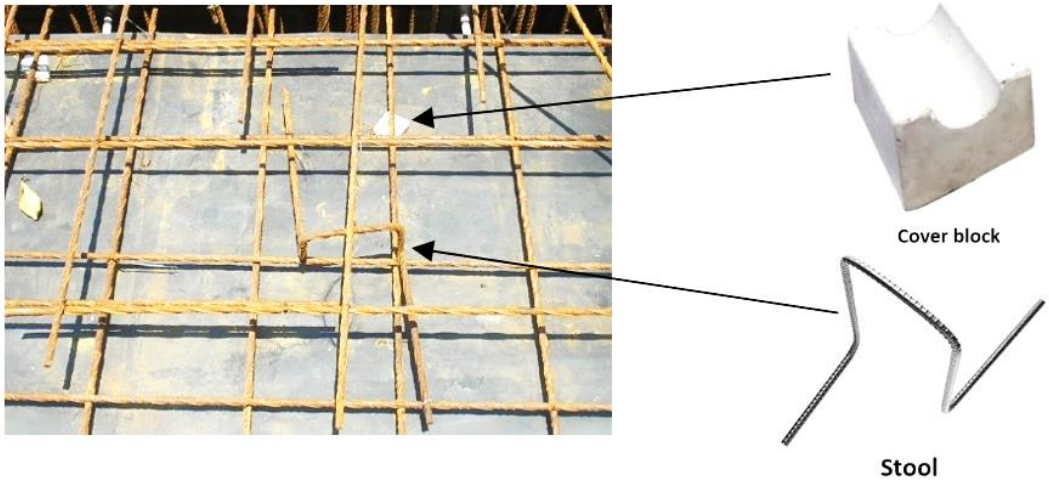
Pitch	Bar mark	Type & size	Total no.of bars	Length of each bars	Total length	Shape & bending dimensions
7B1	15	Y10	32	16'10"	538'8"	16'10"
8B1	17	Y10	34	16'10"	572'4"	16'10"
8B2	12	Y10	24	25'9"	618'	2'6" / 3" / 22'8"
10B1	31	Y10	5	8'	120'	2' / 3" / 5'7"
9B2	6	Y10	10	24'6"	382'6"	1'6" / 4" / 23'6"

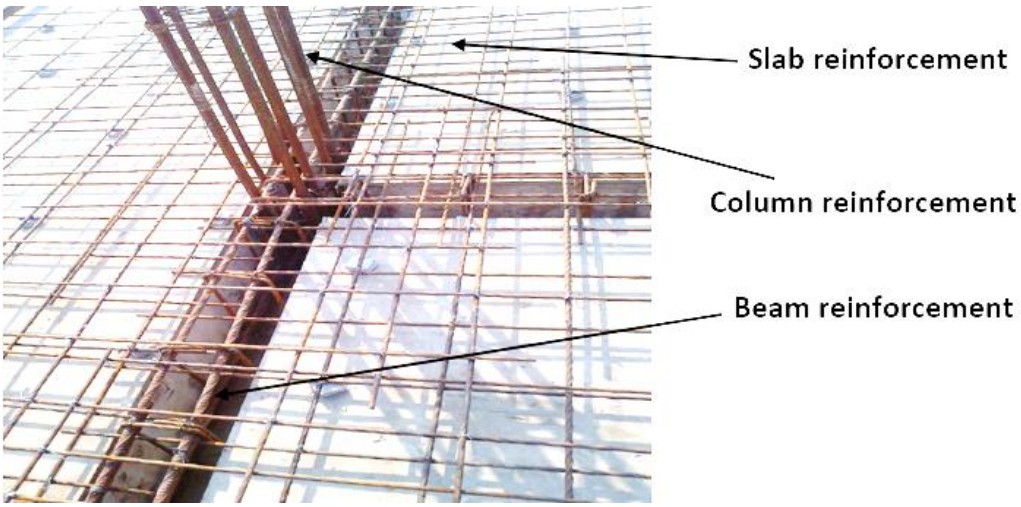
Machine bar cutter is the most used to cut the reinforcement bars in construction projects. The bar cutting machine has a lever mechanism, and the bars should be placed at the point to be cut. There is a limitation on the number of bars that can be cut at a time.

The bars must be bent accurately to the dimensions mentioned in the bar schedule. I should not heat bars without the engineer's approval. If the bar has been bent and straightened, it should not be bent again at the same point or near it.

Preparing covers for reinforcement:

The covers between the reinforcement allow the concrete to flow easily. At construction sites, the covers are provided through Stool and cover blocks. These protect the reinforcement from corrosion, increase the fire resistance and provide good bonding between the concrete and reinforcement.





Concreting

Concrete is a composite material made by combining cement, sand, aggregates, water and chemical admixtures in suitable proportions by allowing the resulting mixture to set and harden over time. Aggregates should be cleaned and free from other

matters. Both excess and lack of water affect the strength of concrete. There are two types of mixes.

- Site mix
- Ready mix

Site mixing is a time consuming and slow method. It is suitable for small or limited concrete works. There are two types of site mixing, which are machine mixing and hand mixing. For small limited concreting works, the hand mixing method is used.

Due to the rapid development of the construction, the construction world demands ready mixed concrete that often competes with quality, price and convenience with concrete mixed on-site. Factory-made concrete is mixed under special supervision with only materials of standard quality being used. The ready-mixed concrete is transported to the site from batching plants in specially designed truck mixers. Admixtures are used to increase the setting time (Setting time is the time taken to harden the concrete). Compared to site mixing, ready mixing has the following advantages.

- Usually of high quality due to well-controlled batching into correct proportions
- Low amount of labour needs
- Saves a lot of time

- No space is needed on site for a mixing plant and storage of materials

Pumping of concrete:

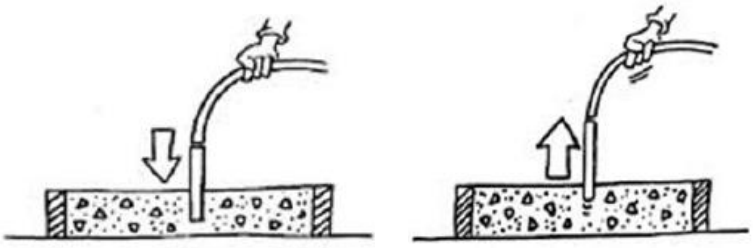

Valves in the pump open and close with definite pauses so that concrete can move in a series of impulses but the pipe always remains full. Pumps can move concrete up to 1,400m horizontally or 430m vertically. Bends should be kept to a minimum. The pipe diameter must be at least 3 times of maximum aggregate size. Pipes need to be primed ('buttered') at the beginning of each period of pumping and cleaned at the end. The required slump range is 50 – 150mm.

Compaction of concrete:

The purpose of compaction is to achieve the highest possible density (by removing air bubbles). The usual method of compaction is by vibration. Air bubbles can occupy between 5% to 20% of the volume of concrete when placed in the form. Vibration has the effect of fluidifying the mortar component of the mix so that internal friction is reduced and packing of coarse aggregate takes place. Vibration

must be applied uniformly to the entire concrete mass. Over-vibration causes segregation.

The poker vibrator is the most common type of vibrator used for this. The rate of application is 5 to 30 seconds at each location spaced 0.5 to 1.0m centres.



Curing of concrete:

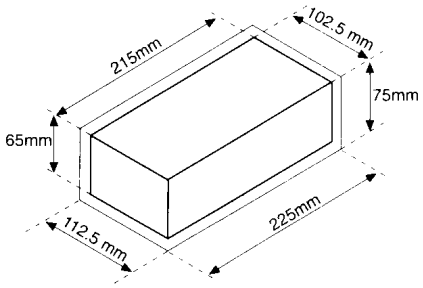
Water should not be allowed to escape from concrete by any means. Hydration of cement takes place in the presence of moisture. Concrete should be cured to retain moisture. Good curing conditions include:

- Covering the concrete with wet plastic film
- Continuously sprinkling with water
- Ponding with water
- Steam curing

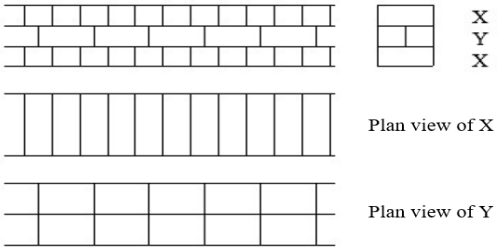
The curing should be started after 24 hours after placing the concrete. It should be kept for at least 7 days (14 days is perfect).

Brickwork

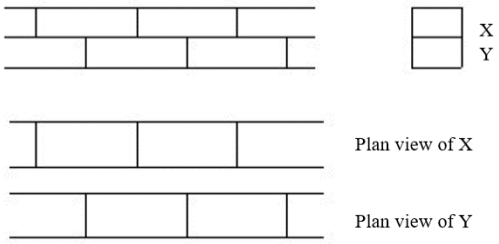
The normal size of a brick is 215mm×102mm×65mm. The usual size of a brick is such that with one mortar joint to each face, the combination shall be 225 mm×112 mm × 75 mm.



There are several types of brick bonding available. Mostly, English bonds and stretcher bonds are used at construction sites.



English bond

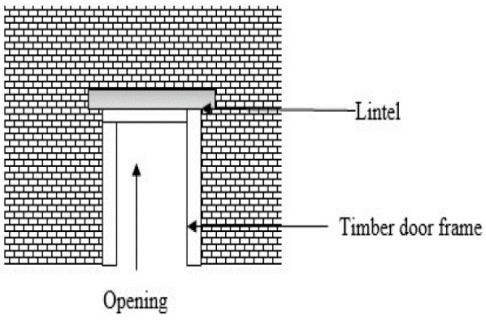


Stretcher bond

The verticality of bricklayers can be checked using the plumb bob, whereas the spirit level can be used to check the horizontality of the walls.

Lintel:

A lintel is provided over the opening and to nest over the walls so that the weight above. The thickness of the lintel depends on the wall size. Generally, it is pre-casted at the site and then placed in the correct position.



Plastering

Plastering provides a decorative finish instead of a rough surface. It protects walls and other structures from atmospheric influences such as rain, snow etc.

Internal walls are not directly exposed to sunlight or any other weather conditions. The strong cementations mix, which can withstand the weather effects, is not necessary for plastering the internal surfaces. A smooth surface is the anticipated result instead. Lime is used to obtain this desired smoothness. Generally, the mixing ratio used for internal plastering is 1:1:5 of cement, lime and sand respectively.

Unlike the internal surfaces, external surfaces are exposed to direct influences of weather conditions. Thus, a strong layer of plastering is necessary to withstand such conditions. A rough finish is expected instead of a smooth surface. Therefore, lime is not used in external plastering. Generally, the mixing ratio used in external plastering is 1:5 between cement and sand.

The walls should be wetted by spraying water on them before applying the plastering layer. The purpose of spraying water is to remove the dust and clean the surfaces for providing a strong bond between the wall and plaster. If there is not enough moisture in the bricks of the wall, they will absorb the water in the plaster, leaving less water for hydration reaction

in cement. This results in a weak layer of plaster. By spraying water before plastering, this can also be avoided.

Skim coating

Skim coating is the process of applying a layer to rough walls and ceilings surfaces to repair them. It is used to give concrete a smooth surface. Generally, two coat layers are used. The second one is more expensive than the first one. Before applying the first coat layer, the surface should be scraped off. A small amount of water should be added to the powder and mixed until it becomes liquid but not watery. It should be looked like butter. Once the first layer is dried, the remaining ridged and bubbles should be scraped off. Some rough areas should be lightly sanded and then cleaned. The second layer coat should then be applied. After all the coats are dried and smooth, the surface has to be sanded before painting.

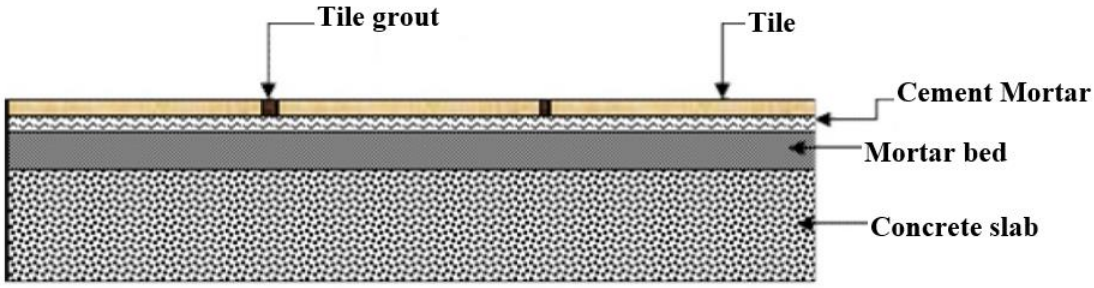
Painting

The main purpose of painting is to provide a decorative finish to obtain clean, colourful and pleasing surfaces. The outside walls need painting for protecting the surface from environmental factors. The type of paint can be decided based on the type of wall / occasion, as mentioned below.

Occasion		Type of Paint
Interior wall		Emulsion
Exterior wall		Weather shield
Partition wall	Timber	Enamel
	Board	Emulsion / Enamel

Tiling

Tiling is one of the good surface finishing and is good water-resistant. Ceramic tiles, clay tiles, cement concrete tiles and granite tiles are some different types of tiles. Generally, tiles are used for walls, floors, balconies, bathrooms and toilets.



Floor tiles are laid on the cement rendered bed. In a floor area, floor tiling is started at the centre of the floor along the centre lines to obtain a symmetrical layout. This is essential in places like corridors as the deviations of the lines can be easily noticeable. Surface preparation is a very important task in tiling work. After the tile bed is placed, setting out should be carried out over the bed area, and tiles should be divided symmetrically over the area. The correct floor levels can be established using levelling instrument.

After setting out, the tiles are pasted to the floor using mortar grout. The mortar grout is applied to the back of the tiles. The mixing ratio is usually Cement : Sand (1:1). The grout has to be applied uniformly and all over the tile. Otherwise, an air gap can be left in the middle resulting in a reduction in the strength of the surface.

A gap of 3mm between adjacent tiles is left for grouting. Tile grout is

protective water-resistant hydraulics cement, which is suitable for filling the gaps between the joints of tiles.

Waterproofing

The main purpose of waterproofing is to prevent water penetration through the concrete structure (especially in the basement, balconies, bathrooms, toilets, water tanks and sumps). The water penetration into the concrete structure causes erosion in reinforcement. Then, the structure would have to fail in tension. In general, concrete is a waterproofed material. But, the waterproofing layer is applied, considering the long term aspect of concrete durability during the building service stage.

Before applying the waterproofing layer, the garbage and the wastes (woods, concrete pieces, etc.) should be removed, and the surface should be washed. The pressure gun can be used for this purpose. The drained water can be removed using a submersible pump.

Carpentry work

Carpenters construct, install and repair structures and fixtures of wood, plywood and wallboard using carpenter's hand tools and power tools. If I involve in carpentry work, I should have the ability to perform the following activities.

- Following blueprints and building plans to meet the needs of clients

- Installing structures and fixtures, such as windows and moulding
- Measuring, cutting, and shaping wood, plastic and other materials
- Constructing building frameworks, including walls, floors, and doorframes
- Erecting, levelling and installing building framework with the aid of rigging hardware and cranes
- Inspecting and replacing damaged frameworks or other structures and fixtures

Plumbing

Plumbers install and repair pipes that supply water. They also install plumbing fixtures such as bathtubs, sinks, toilets and appliances, including dishwashers and washing machines.

If I involve in plumbing work, I must be able to perform the following tasks ensuring the proper functioning of the properties in the plumbing systems.

- Installing pipes and plumbing fixtures
- Operating test equipment such as pressure and vacuum gauges to determine the cause and location of trouble
- Clearing obstructions from sink drains and toilets
- Troubleshooting problems and deciding how to fix them
- Repairing pipes and plumbing fixtures
- Estimating costs of installations and repairs
- Presenting recommendations and related pricing to customers

Welding

Welder cuts and joins metals and other materials using a variety of welding tools. If I involve in welding work, I must be able to perform the following tasks.

- Reading blueprints and drawings, and taking/reading measurements to plan layout and procedures
- Selecting the appropriate welding tools or methods based on the requirements
- Using the necessary safety wear and instruments during the welding process
- Setting up the components for welding according to the specifications
- Operating angle grinders to prepare the parts that should be welded
- Aligning the components using calipers, rulers etc.
- Welding components using manual or semi-automatic welding tools in various positions (vertical, horizontal or slant)
- Repairing machinery and other components by welding pieces and filling gaps
- Testing/inspecting welded surfaces and structures to discover flaws
- Maintaining tools in a condition that does not compromise safety

4.3. How to handle the equipment properly in machinery operations?

In the previous sections, the instructions are sufficiently given to handle the equipment and tools for each type of task/operation. However, I should follow the general procedures and good practices to handle/maintain the equipment safely, as mentioned below.

- I should thoroughly understand the operations of the equipment which is to be used. I should have read the manual/handbook provided for operating the relevant equipment. The instructions mentioned in the manual/handbook can help me to use the equipment to its full potential. I can also find new things that the relevant equipment can do, even after years of use. The accidents and costly damages can also be easily avoided.
- I should know how to adjust the maintenance of equipment to different environments. Before starting to operate the equipment, I should also consider the workplace environment. Considering the environmental conditions (such as dust, temperature and heat effects, wind, sand, rain, etc.), the equipment should be kept/operated safe and clean from the elements. The necessary storage facilities and covers should be provided to protect the electrical components of the equipment (eg. electrical wires) in rainy climates.

- I should create a specific schedule for the required tasks that need to be performed for the effective maintenance of the relevant equipment according to the manual/handbook.
- I should keep the records of the usage of equipment with the schedule. This will also assist in tracking equipment performance. I can then easily find the repeated issues and work out solutions to fix or avoid them in the future.

Unit 5
Material Handling in Construction Works

This unit helps the construction workers for improving their material handling abilities during the construction works. The contents included in this unit will be very useful for the construction supervisors to provide necessary work-based training exercises and conduct performance evaluations of workers towards the following elements of outcomes.

The workers will be able to

- use construction materials in their work with a basic understanding of the properties and behaviour of materials.
- handle tools properly following the procedures in material testing activities.

This unit provides necessary procedures, explanations and solution guidelines that need to be followed by the construction workers for the following questions.

- How can I use construction materials (concrete, steel, timber, etc.) in my work with a basic understanding of material properties and behaviour?
- How to handle tools properly in material testing activities?

In the previous sections, the instructions are given up to some level related to the usage of construction materials and tool handling in material testing activities. However, the contents included in this unit will be helpful for further improvement of my competencies under the following questions.

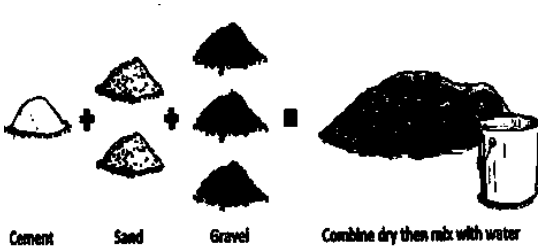
5.1 How can I use construction materials (concrete, steel, timber, etc.) in my work with a basic understanding of material properties and behaviour?

5.2 How to handle tools properly in material testing activities?

In general, a variety of materials are used in various construction operations. The most important reason for the risk of minor cracks and breakage in some constructions is the failure to use the best materials in the right way. I should have a basic understanding of the properties and behaviour of those materials as well as handling operations for the testing of materials. I should consider the important aspects in selecting or using the construction materials, such as strength, durability, environmental conditions, price, availability and the required work process.

Concrete

Concrete is a composite material made by combining cement, sand, aggregates, water and chemical admixtures in suitable proportions by allowing the resulting mixture to set and harden over time. The hardened concrete is a relatively brittle material with low tensile strength (Hence, the steel bars are used in the reinforced concrete to increase the tensile load-bearing capacity and the toughness of the structure).



The concrete should be properly mixed to the correct ratios depending on the grade of concrete. The standard recommended compositions are as follows and the concrete grade is decided according to the requirement of the structure.

Group	Grade of Concrete	Proportion (Cement: Sand: Aggregate)	Applications
Ordinary concrete	Grade 10	1:3:6	Non-structural works like patio slabs and pathways
	Grade 15	1:2:4	Pavement kerbs and floor blinding
	Grade 20	1:1.5:3	Internal floor slabs, flooring for the workshop, garages and driveways
Standard concrete	Grade 25	1:1:2	Foundations and reinforced concrete elements
	Grade 30	1:0.75:1.5	Roadways and reinforced concrete elements
	Grade 35	1:0.5:1	Water tanks, septic tanks and reinforced concrete elements
	Grade 40	1:0.25:0.5	

Aggregates should be cleaned and free from other matters. Both excess and lack of water affect the strength of concrete. There are two types of mixes.

- Site mix
- Ready mix

Site mixing is a time consuming and slow method. It is suitable for small or limited concrete works. There are two types of

site mixing, which are machine mixing and hand mixing. For small limited concreting works, the hand mixing method is used.

Due to the rapid development of the construction, the construction world demands ready mixed concrete that often competes with quality, price and convenience with concrete mixed on-site. Factory-made concrete is mixed under special supervision with only materials of standard quality being used. The ready-mixed concrete is transported to the site from batching plants in specially designed truck mixers. Admixtures are used to increase the setting time (Setting time is the time taken to harden the concrete).

Cement

Though there are many types of cement available, ordinary Portland cement is the type commonly used in various construction activities.

Types of Cement	Description / Usage
Ordinary Portland cement (OPC)	The most common type of cement which is used for general concrete
Rapid hardening Portland cement	A finer cement used to give high early strength
Low heat Portland cement	Used for massive concrete pours such as dams to reduce the heat of hydration generated during the chemical reaction.
Sulphate resisting cement	Used to resist sulphate action. (Sewage

	linings, marine structures, foundations and basements where soil contains sulphate)
White Portland cement	Used to produce white concrete for prestige construction projects and decorative work. White concrete usually takes the form of pre-cast cladding panels since it is not economical to use white cement for structural purposes.

I can do the following tests at the construction site to check the quality of the cement before its usage.

- Checking the date of manufacture (which can be seen on the bag) is important because the strength of cement reduces with age.
- The cement should be uniform in colour. Typically, the colour of cement is grey with a light greenish shade. The colour of cement gives an indication of excess lime or clay and the degree of burning.
- When taking a pinch of cement between fingers and rubbing it, it should feel smooth. If it is rough, that means adulteration with sand.
- When thrusting the hand into the cement bag, it should give a cool feeling. This indicates that no hydration reaction is taking place in the bag.
- When throwing a small quantity of cement in a bucket of water, it should sink and should not float on the surface.
- When taking a pinch of cement and smelling it, the paste will give an earthy smell if the cement contains too much-pounded clay and silt as an adulterant.
- The lumps should not be present in the bag.

When the Portland cement is mixed with the water, a chemical reaction (hydration) occurs producing a hardened paste after about 45 minutes. It takes around 10 hours after mixing to be fully hardened. The compound gains further strength until about 28 days.

Aggregate

Aggregates occupy about 75% of the volume of concrete and are obtained either from naturally occurring deposits of sands and gravels or are produced by crushing quarried rock. The aggregate can be categorised into two based on the particle sizes, as follows.

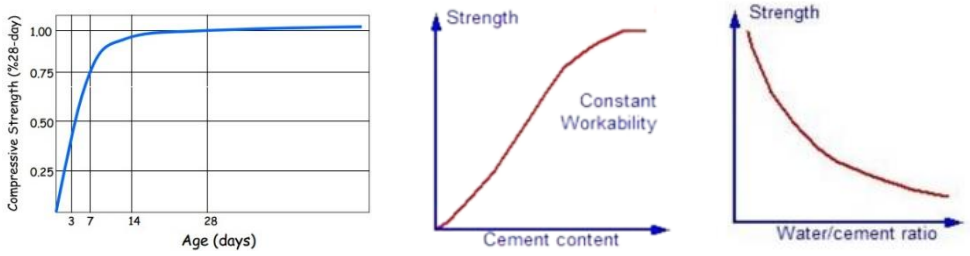
- Fine aggregate (Less than 4.75mm in size) – Sand
- Coarse aggregate - Generally crushed from rocks of granite and the harder types of limestone & sandstone

Water

Although water itself is often not considered when dealing with materials that go into the production of concrete, it is an important ingredient. Typically, 150 to 200 kg/m3 of water is used. The amount of water should be decided based on the mixing design requirements.

Compressive strength of concrete

The compressive strength is defined as the measured maximum resistance of a concrete specimen to an axial load at an age of 28-days. When the water amount is increased without changing the cement amount, the compressive strength of concrete will be decreased. When the cement amount is increased without changing the water amount, the compressive strength of concrete will be increased.



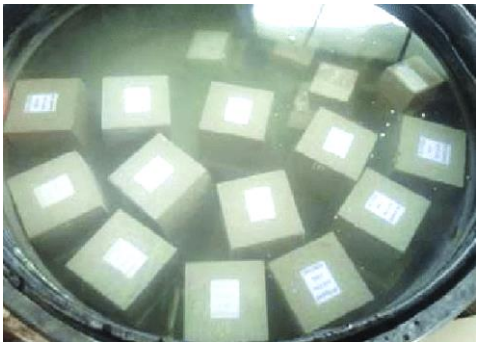
Cube test

This test is carried out to determine the compressive strength of the hardened concrete. The procedures need to be followed as given below.

- Check the standard concrete moulds whether they are clean and dimensionally correct (150mm in length, width and height). The components of the mould can be detached and re-assembled. The grease should be applied to the internal surfaces before placing the concrete sample into the mould.

- The randomly collected concrete samples should be placed into the mould in three layers, where each has a 50mm thickness. Using a rod, 35 blows should be given to each layer. The purpose of this compaction process is to provide the vibration for removing the air bubbles inside the concrete. Else, the strength will be reduced due to the air bubbles. Then the top of the concrete surface should be smoothened and labelled with the name of the location of the site and the time. Accordingly, the required number of samples can be prepared and kept carefully for 24 hours.

- The next day, the concrete samples will look hardened. Then, the concrete cubes should be extracted from the moulds (That's why the grease is applied on the internal surface of the moulds before adding the concrete), and all the concrete cubes should be fully submerged in the water. This is called 'curing'. The curing is done to avoid excessive water reduction inside the concrete for ensuring the proper chemical reactions between the cement component and water.



- A number of concrete cubes can be taken from the water bucket on different days to test the compressive strength using the compression testing machine. The machine applies the compressive force to each test cube separately using a hydraulic mechanism. The crushing strength is taken as the compressive strength, which can be directly read from the dial gauge. Finally, the average strength can be taken as the compressive

strength of the test cubes. The results will be compared with the requirements.

Workability of concrete (Fluidity)

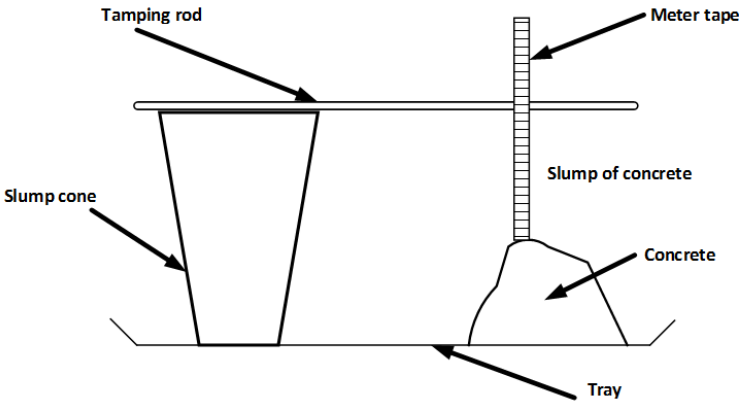
Workability describes the ease of placing the mix and can be directly altered by changing the water and cement amount. The shape, size and texture of the aggregates also have some effect. For example, rounded stones generally produce more workable mixes than crushed angular material. The workability of concrete can be increased without adding more water by using admixtures (plasticizers).

Slump test

Generally, the slump test is carried out to check the workability of concrete at the construction sites. The procedures need to be followed as given below.

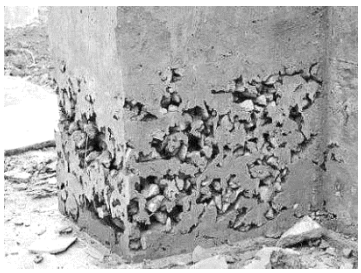
- At first, the cone and plate should be cleaned. The cone should be placed on a metal surface.

- Then, the concrete sample should be placed inside the cone in 3 layers, where each having a 100mm height. Each layer is compacted 25 times with the rod. The reason for this compaction is to remove the air bubbles from the sample mix.
- After filling those 3 layers with the compaction, the cone should be slowly moved vertically allowing the mix to flow.
- Finally, the slump is measured as the distance between the top of the cone and the highest point of the concrete.



- After finishing the tests, all the apparatus should be cleaned with water and dried.

Segregation



Segregation of concrete is the separation of cement paste and aggregates of concrete from each other during handling and placement. Segregation also occurs due to over-vibration or compaction of concrete, in which cement paste comes to the top and aggregates settle at the bottom. The followings are the conditions favourable for segregation.

- Insufficiently mixed concrete with excess water content.

- Dropping of concrete from heights as in the case of placing concrete in column concreting.
- When concrete is discharged from a badly designed mixer.
- Conveyance of concrete by conveyor belts, wheelbarrow, long-distance, long lift by skip and hoist are the other situations promoting segregation of concrete.

Bleeding

Bleeding is the development of a layer of water at the top of freshly placed concrete that is caused by the settlement of solid particles of cement and aggregate, and the simultaneous upward migration of water. As water moves up, the water/cement ratio in the lower part of the element is reduced. This results in a higher water/cement ratio in the upper part resulting in reduced strength.

Concrete mixers

Concrete mixers are classified according to the method of discharging concrete.

- Tilting mixer – The mixing chamber (drum) is tilted for discharging
- Non-tilting mixer – Axis of the mixer is always horizontal. Discharge is obtained by inserting a chute into the drum.
- Pan-type mixer – Similar to electric cake mixers in operation

Type of mixer	Functions
Tilting mixer 	• Mobile. • Mixing occurs due to the free fall of concrete inside the drum. • Usually have a conical or bowl-shaped drum with vanes inside. • Discharge action is always good as all the concrete can be tipped out rapidly. • Preferable for mixes of low workability. • Discharge is very rapid and unsegregated.
Non-tilting mixer 	• Mobile. • Mixing occurs due to the free fall of concrete inside the drum. • The axis of the mixer is always horizontal. • The rate of discharge is slow. • Segregation can occur.
Pan-type mixer 	• Not mobile. • The circular pan rotates about its vertical central axis. • Stars of paddles rotate about a vertical axis. • Concrete in every part of the pan is thoroughly mixed.

Bricks

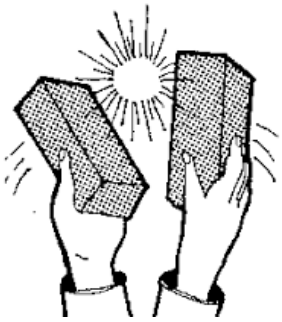
The followings are the reasons for the selection of bricks in most situations.

- Low cost compared with other types (concrete block)
- Suitable for partition wall (125mm thickness wall)
- Low weight suitable for high rise building

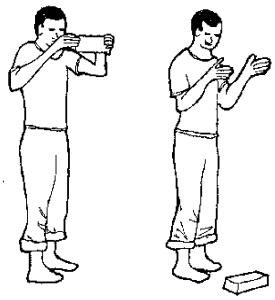
- Good fire resistance
- Good sound & thermal insulation
- It gives a good appearance
- Easy to breakable

I can do the following tests at the construction site to check the quality of the bricks before their usage.

- When taking two bricks, one in each hand and stucking it each other, if a metallic sound or ringing sound is heard, the quality of bricks can be decided as good. If brick breaks without sound, then it should not be used in construction.



- When dropping a brick on a concrete surface from the height of 1.5m to the ground (from the shoulder height level), if it is not broken, the quality of the bricks can be considered good.



Before the bricks are used for construction, they should be put into the water for at least one hour. If not, the bricks would absorb water from the cement mixture, and this would reduce in hydration reaction in cement resulting in a reduction in the strength of the walls.

The mortar used in brickwork transfers the stress, compressive and shears uniformly between adjacent bricks. This provides good workability and proper bonds between the bricks. Mortar mixing is manually done to join the bricks. The mortar with the cement : sand ratio of 1:5 is used mostly.

Concrete blocks

Concrete blocks are widely used in building construction, and they are comparatively more economical than the other types of partition walls. Concrete blocks have a comparatively good shape, and the chances of making errors during construction are low. Further, the concrete block has adequate strength to be used as a load-bearing wall. Cement, water and aggregate are the main ingredients for the production of concrete blocks. Various types of aggregates can be used in block production, such as crushed stone, gravel, volcanic cinders, foamed slag, furnace clinker, etc.

Mainly there are two types of concrete blocks, namely solid blocks and hollow blocks. The solid blocks have a rectangular solid shape. In general, they are available in different dimensions. Considering the hollow blocks, as the name implies, it is a hollow section with a rectangular shape. They are also available in the same dimensions as solid blocks. A hollow block reduces the heat transfer and works as a sound barrier due to its hollow shape. It can also be used to carry the services such as electrical conduits, pipes, etc.

Advantages of concrete blocks	Disadvantages of concrete blocks
• Lightweight especially the hollow blocks • No changes in the dimensions, perfect shape • Easy handle and lesser wastage • Stronger than the normal brick • It increases the floor areas since the width of the wall is comparatively smaller. • It allows speedy construction. • Good thermal insulation, fire resistance and sound resistance • Easy availability in the market • Can be produced in bulk quantities with the construction demand	• Low stiffness of the hollow blocks • It is very difficult to construct bathrooms using hollow blocks. In usual construction, the grooves are cut in the walls to place the pipes. But, this cannot be done in the hollow blocks.

Granite

Granite is a sturdy and reliable material that provides some good interior design opportunities for building construction. It has become one of the most popular building materials in modern construction, especially in kitchen surfaces and paving slabs. Granite has good fire and heat resistant properties, and it has become one of the most popular building materials in modern construction, especially working tops in kitchens and laboratories.

Marbles and tiles

In general, marbles and tiles are a kind of hard and highly polished materials that can be used for buildings, monuments and interior decoration. They provide the beauty of the surfaces and have good resistance to fire and erosion. Marbles are the most elegant natural and highly polished stones which give such stylishness to the floor areas. Tiles are more suitable for harsher applications, such as flooring. It is generally used for covering roofs, floors, walls or other subjects such as the top of a table. Tiles are generally cheaper than marbles for the flooring options.

Glass

Glass is most typically used as transparent glazing material in buildings, especially for windows on the external walls. It is also used for internal partitions as an architectural feature. Glass is recyclable and can be used as aggregates in concrete construction. Though the glass is generally a brittle material, certain laminates and admixtures can increase the ability to resist deformation under loads.

Float glass (also known as soda-lime glass) is the most widely used type of glass in construction. It has high transparency and can cause glare. It is used in making canopies, shop fronts, glass blocks, railing partitions, etc.

Laminated glass is the type of glass made by sandwiching glass panels within a protective layer. It is heavier than normal glass and may cause optical distortions as well. It is tough and protects from UV radiation. It also insulates sound up to some level. Laminated glass is used in glass facades, staircases, floor slabs, etc.

Lime

Lime is generally used to obtain the desired smoothness in mortar mixes. It allows the cement and sand mixture to remain strong. The lime added mortar is permeable and allows for the diffusion and evaporation of moisture. It has a high pH leading to acting as a fungicide. Further, it provides building a breathing property. Lime let the building be vapour-permeable, thus allowing it to breathe. This stabilises the internal humidity and reduces the chances damage of to the building.

Plastic

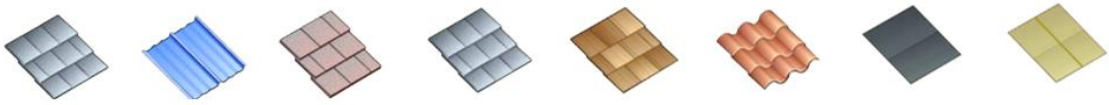
Plastic is used in a wide range of applications in construction activities, considering its lightweight, durability, cost-effectiveness, low maintenance and corrosion resistance. Plastic in construction is mainly used for pipes, cables, floor coverings, cladding profiles and insulation. Plastic has strength with lack of weight, it is easily formable, and its lightweight enables easy transportation.

Timber / Wood

Timber is used for making furniture, such as doors, windows, cupboards, shelves, tables, railings etc. The timber should be

dried till it reaches the equilibrium moisture content before its usage. As a result, the strength and durability will be increased, and it will become lightweight and easier to work with the saw and other tools. Teakwood is the most appropriate type of timber used in the construction of buildings. Teakwood is naturally durable and suitable for outdoor use and indoor environments with high moisture content like kitchens and bathrooms. It can be used for panelling and flooring in the kitchen and bathrooms due to its natural water resistance.

Roofing materials



The roofing materials are selected based on the type of building, costs, maintenance requirements, fabrication facilities, appearance, special features and climatic conditions. In general, roofing tiles are used to cover sloping roofs, supported on wooden reapers or steed rods. The roofing tiles should

- not absorb the moisture of more than 20% by weight.
- be capable of taking a load of a man safely after they are supported on reapers.
- be durable and give pleasing look.
- be uniform in shape and size.

Burnt clay tiles

Clay roofing tile is heavy, requires a strong substructure and is a good choice for residential purposes. These tiles are durable

(100 years), suitable for all climatic conditions, good for waterproofing, will not rot or burn and cannot be harmed by insects. The colour of the clay tile is not affected by exposure to the elements. The production of clay tiles is a traditional village craft in many regions, and the uniform shapes and qualities are difficult to achieve. The clay tiles require inspections at least twice a year so as to last for further years. A major problem with the clay tiles is the immense loss due to cracking and breakage. A cracked tile needs to be replaced or repaired in place. Else, the tiles should be mixed up with a small amount of mortar and the crack should be carefully filled. The tiles should then be sure to wet with plenty of water for setting up the mortar properly.

Concrete roof tiles

The mixture is composed of normal Portland cement and well-graded sand. The body of the tiles is generally treated with mineral granules that are coated with the colour. These tiles are durable (30-50 years), provide good fire protection and require low maintenance. These tiles are also resistant to rot and insects.

Asbestos sheets

Asbestos sheets are commonly used to lay the roofs of some houses. These sheets have a good fire-resistant property and do not burn easily. These sheets are also resistant to electricity, making them perfect for installing near electrical outlets.

Painting materials

Oil paint

Oil paints use white lead as a base and are applied in three coats which are primer, undercoat and finish coat. Oil paints are commonly used in walls, doors, windows and metal structures. They can achieve glossy finishes while being durable and affordable. They are characterised by their ease of application, and painted surfaces can be easy to clean. Before applying the oil paints, linseed oil and pigments should be added. The oil paints are not suitable for humid conditions, and they take more time to dry completely.

Enamel paint

The enamel paint is produced by adding lead or zinc to varnish. Pigments are added to achieve a wide variety of colours. Enamel paints form hard and glossy coatings, which can be easily cleaned. They are characterised by being waterproof and chemically resistant, offering good coverage and colour retention. The enamel paints are used for interior and exterior walls, flooring, wood trims, doors, windows, stairs and the surfaces like wicker, masonry, concrete, plaster, glass, and metals. The enamel paints are slow drying and require a titanium coating before their application.

Emulsion paint

Emulsion paints use polyvinyl acetate and polystyrene as binding materials, containing driers like cobalt and manganese. The

emulsion paints can be water or oil-based, and pigments are used to achieve the desired colour. They are characterised by their fast drying and hardening, and surfaces can be cleaned easily with water. Emulsion paints are commonly used for interior walls, ceilings and masonry work. Some specialised types of emulsion paints can be used for woodwork too.

Cement paint

Cement paint is available in powder form, which is mixed with water to achieve paint consistency. The base material is white or coloured cement, and it may also contain pigments, accelerators and other additives. Cement paint is durable and waterproofed. Cement paint is commonly used in rough internal and external surfaces. The cement paint has a long drying time (typically 24 hours). To prevent dampness issues, the cement paint should generally be applied in two coats.

Bituminous paint

The bituminous paint is made from dissolved asphalt or tar, which gives it a characteristic black colour. It is waterproofed and alkali-resistant, but not suitable for its applications where it will be exposed to the sun. Bituminous paint is commonly used in underwater ironworks, concrete foundations, iron pipes and wooden surfaces. It is also used to provide rust resistance on metal surfaces.

Aluminium paint

The aluminium paint is produced by mixing aluminium particles with oil varnish. It is resistant to corrosion, electricity and weather exposure. It is commonly used for metals and wood, and some specific applications in gas tanks, oil tanks, water pipes and radiators.

Synthetic rubber paint

Synthetic rubber paint is made from dissolved synthetic resins, including pigments. Chemical resistance and fast drying are the main benefits of this type of paint. Synthetic rubber paint is used for concrete surfaces in general.

Cellulose paint

The cellulose paint is produced from celluloid sheets and amyl acetate. Cellulose paints are very expensive and commonly used in cars and aeroplanes. This type of paint is characterised by its quick-drying, smooth finish and hardness. It also offers resistance to water, smoke and acids.

Plastic paints

The plastic paints use water as a thinner, and these are available in a wide range of colours. The plastic paints dry very quickly and offer high coverage. These are used on walls and ceilings of auditoriums, showrooms, display rooms, slabs and decks.

Silicate paint

Silicate paint is made from a mixture of silica and resinous substances and is commonly used in metal structures. Good adhesion, hardness, heat resistance, and being chemically unreactive with metals are the benefits of this type of paint.

Materials used for pipe laying

Different types of piping materials are used for different uses in the plumbing systems, including freshwater supply, waste drainage, irrigation, gas supply and so on. The older plumbing system was dominated by cast iron and galvanised iron, but the new plumbing systems mostly use various types of plastic pipes (such as PVC and CPVC). The following tables describe the materials commonly used in different types of plumbing lines.

Types of plumbing lines	Types of materials
Water supply	Chromed copper, Galvanised iron, CPVC (Chlorinated Poly-Vinyl Chloride), PEX (Cross-linked Polyethylene)
Waste water supply	Cast iron, PVC (Poly Vinyl Chloride), Chromed brass
Gas pipes	Black iron

Types of materials	Uses	Cutting and fitting
Cast iron 	Main soil stack waste lines and vent pipes	A heavy-duty reciprocating saw or a special cutting tool (called a cast-iron pipe) is required.
PVC (Poly-Vinyl Chloride) 	Sanitary waste lines, vent pipes, and drain traps	PVC pipe can be easily cut using a hacksaw or tubing cutter. The sections can be joined together mechanically, using plastic pressure fittings for later removal. They can be joined permanently using a special

		chemical solvent.
Chromed brass 	Exposed drains and traps	The pipes can be easily cut using a hacksaw, and the components can be joined with slip fittings.
Chromed copper 	Exposed water supply lines (supply tubing for toilets and pedestal sinks)	The pipes can be easily cut using a tubing cutter or hacksaw, and the components can be joined with chromed brass compression fittings.
Galvanised iron 	Water supply and drainage (in older homes)	The pipes can be cut using a reciprocating saw or hacksaw, and the components can be joined using threaded galvanised iron fittings.
Copper (Rigid and Flexible) 	Rigid copper pipes are used for longer runs of water supply and in some cases as waste lines in the home. Flexible copper is used in short runs for water supply and for the water supply tubing in refrigerators and dishwashers. Copper can also be used for gas piping.	Copper pipes can be easily cut using a tubing cutter or hacksaw, and the components can be joined together with soldered copper connectors or copper compression fittings.
PEX (Cross-linked Polyethylene) 	Cross-linked Polyethylene is used for water supply and radiant heating pipes.	The pipes can be cut and fit with specialised fittings and tools.

CPVC (Chlorinated Poly Vinyl Chloride) 	CPVC is commonly used for hot and cold water supply piping.	The pipes can be easily cut using a tubing cutter or hacksaw, and the components can be joined permanently together using plastic fittings and solvent glue, or with grip fittings where the pipes may need to be disassembled in the future.
Black steel 	Black steel is generally used for natural gas or propane supply pipes. It is often used for feeding gas supply to the furnace, boiler or water heater.	The pipes can be cut using a reciprocating saw or hacksaw or a tubing cutter for smaller pipes. The components can be joined using threaded black pipe fittings.

Road materials

ABC (Aggregate Base Course)

Generally, ABC is paved after completing of sub-base and the drainage works. ABC layer consists of larger grade aggregate and quarry dust spread and compacted to provide a stable base for further layers of aggregates or asphalt pavement. In general, aggregates of 37.5mm, 20mm, and 10mm are used. After placing the ABC, it should be compacted well using the rollers, and the compaction shall be tested. A minimum of 98% of the degree of compaction is required. The degree of

compaction is the ratio of the field dry density (determined by core cutter or any other method) to the maximum dry density determined in the laboratory (by Proctor apparatus).

Asphalt

Asphalt is generally used for constructing and maintaining roads. The asphalt is made by blending small pebbles, stones, sand and other filler with the bitumen as a binding agent. Bitumen is formed from petroleum. The difference between the bitumen and the asphalt is simply a matter of the amount of sand and filling agents used in the mixture. Asphalt is durable, inexpensive and ideal for coating large areas. It is also resistant to rain, sleet, snow and heat. The broken or damaged asphalt can be recycled or reused in certain situations, further lowering the cost of asphalt overall.

Bitumen Asphalt

Unit 6
Green Practices
in Construction Works

This unit helps the construction workers for improving their abilities to apply green practices in the construction works. The contents included in this unit will be very useful for the construction supervisors to provide necessary work-based training exercises and conduct performance evaluations of workers towards the following elements of outcomes.

The workers will be able to

- follow the green practices in their works (eg. water supply, waste disposal, material usage, etc.) with the understanding of the importance of environmental sustainability.
- explain the importance of the application of energy conservation methods and other green practices to co-workers.

This unit provides necessary procedures, explanations and solution guidelines that need to be followed by the construction workers for the following questions.

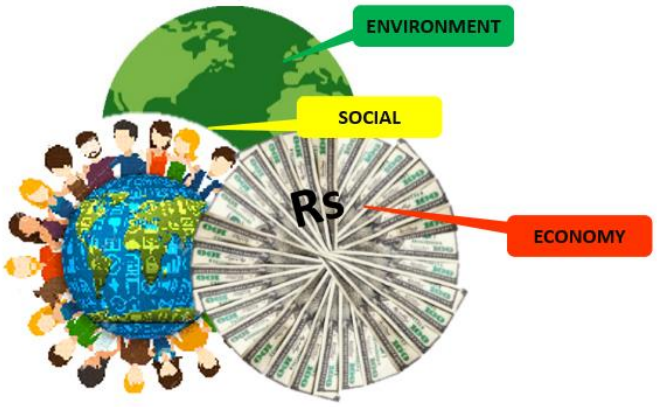
- Why do I need to follow green practices in my work?
- How can I use the green practices in my work (eg. water supply, waste disposal, material usage, etc.) with the understanding of the importance of environmental sustainability?

- How can I make my co-workers also understand the importance of the application of energy conservation methods and other green practices?

6.1 Why do I need to follow green practices in my work?

The concept of green practices aims to improve the efficiency of usage of resources (such as energy, water and materials) towards reducing the impact of construction on human health and its surrounding environment during all the stages of construction, namely design, construction, operation and maintenance. Green practices not only reduce or eliminate negative impacts on the environment (by using less water, energy or natural resources) but also provide a positive impact on the environment in many cases by generating own energy or increasing biodiversity. The major benefits of green practices are

- Reducing environmental impacts (heat effects, construction wastes, greenhouse gases, etc.)
- Saving energy, water and other resources
- Reducing operational and maintenance costs



6.2 How can I use the green practices in my work (eg. water supply, waste disposal, material usage, etc.) with the understanding of the importance of environmental sustainability?

There are many good practices that I need to follow in my work, as described below.

I should try to make natural ventilation and lighting facilities, especially in public areas.

Cross ventilation with a natural environment

Cross ventilation with the created environment

Natural ventilation leads to remove the condensation and humidity from the air and gives clean and breathable air. It also reduces operational and maintenance costs.


Natural lighting

The natural light acts as a disinfectant, reducing the bacteria and dust mites in the living area. This energises the place and creates a lively feeling for occupants by improving their physical and psychological wellbeing. Exposure to natural light helps the human bodies produce Vitamin D that prevents bone loss and reduces the risk of heart disease, weight gain and cancers.


Landscaping around the construction

By making good landscaping around the construction, the indoor air quality can be improved and the heat effects can be prevented.

Solar and wind power

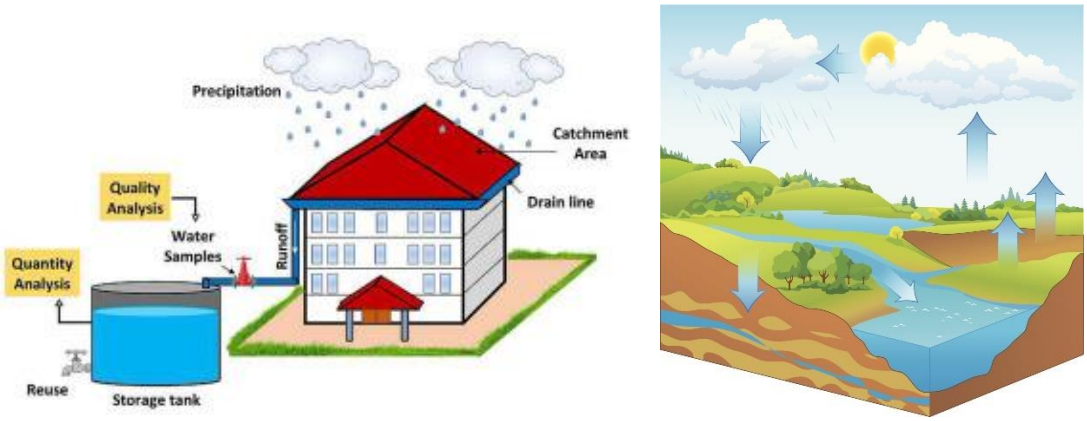
Usage of solar power and wind power in buildings conserves energy as well as saves high operational and maintenance costs.

The following practices can improve the water efficiency in the operational and maintenance stages of construction.

Water efficient landscaping

Innovative technologies for wastewater treatment

Reduction of water usage



Innovative water transmission - Rainwater harvesting and groundwater recharge

Considering the green practices for storage, collection and usage of recyclables,

- Different colours and symbols can be used to recognise the bins.

Different types of construction waste

Waste disposal bins

  - Waste minimisation reduces landfill spaces and costs expenditure.

- Organic food waste can be used to produce compost for plants in the garden. This may lead to cost reduction, high harvest and producing healthy and eco-friendly fruits and vegetables.

- Broken tiles, pipe cut the ting pieces, remaining glass pieces and wood pieces can be sent to recyclable centres for recycling. Pieces of iron bars can be sent to manufacturing to make full bars.

- Removal parts of concrete mixture and cement can be entered into the crushing machine again to make the concrete mixture. Crushed recycled concrete can be used as the dry aggregate for fresh concrete.

- Sanitaryware can be reused as it is if they are not damaged. Chipped/cracked sanitarywares can be reused as construction infill or filler in concrete. They can be used to grow plants as well.

- Removal tires found in the site area can be used to make the benches.

- Removal of paint cans and glass bottles can be used to grow the plants.

- Potion of the timber which is not reused on-site can be donated to the community.

- The methods of diversion can be used for the construction wastes, as shown in the following table.

Material	Method of diversion
Concrete	Dry aggregates
Brick	On site reused as filling
Timber	Recycling / Community donate
Steel	Recycling
Asbestos	Recycling
Glass	Recycling
Cardboard	Paper recycling
Plastic	Recycling

The following rapidly renewable materials can be used to improve green practices.

- Bamboo

  Bamboo is a lightweight wood and fast-growing renewable material that can be used for framing buildings, shelters and staircases. It replaces expensive and heavy imported materials. It provides an alternative to concrete and rebar construction.

- Hempcrete blocks

  Hempcrete is the material created from the woody inner fibres of the hemp plant. The hemp fibres are bound with lime to create concrete-like shapes that are strong and light. Hempcrete blocks are super lightweight, which can also dramatically reduce the energy used to transport the blocks, and it is a fast-growing renewable resource.

- Straw bales

  Straw bales can be used to create summer huts, replacing other building materials such as concrete, wood, gypsum, plaster, fibreglass or stone. Straw bales naturally provide very high levels of insulation for a hot or cold climate, and they are not only affordable but sustainable as straw is a rapidly renewable material.

It is important to increase the demand for the materials and products that are extracted and manufactured within the region, thereby supporting the regional economy and reducing the environmental impacts resulting from transportation.

It is also important that I should involve in my work considering the aspects of cultural diversity. Love and belonging are important for everyone to be a part of a group such as family members, colleagues in a workplace, friends and other social groups in the society. It helps humans to have the confidence in their own abilities to contribute reasonably to the decision-making process that promotes community development in society. This leads to keeping self-respect, recognition, reputation, status and self-worth for individuals in their respective social groups when it is obvious that they feel secure in the society.

6.3 How can I make my co-workers also understand the importance of the application of energy conservation methods and other green practices?

It is my responsibility to make my co-workers, friends, neighbours and family members understand the importance and benefits of the application of energy conservation methods and other green practices.

First of all, I should explain the contents that I learned in the previous sections (6.1 and 6.2) to others. I can also ask for their ideas and opinions regarding green practices. They can also come up with different innovative ideas to save energy. All the workers should find out what are the energy-saving policies and responsibilities mentioned in our job descriptions. I can also try to write some articles, design posters and create short videos to increase social awareness on the importance of green practices for society.

If my organisation have some policies to reward the staff members who adopt energy-saving practices and apply those to the work operations, it would be so good.
Offering incentives and using the healthy competitiveness of workers can encourage everyone to engage with green practices.

Why don't I join the voluntary activities of Green Building Councils, such as green talks and green walks? Let's join with my co-workers?


LED Lighting
Solar Panels
Electric Car Charger
Nucleus Appliances
Water Heater
Water Filtering

Unit 7
Management Practices for Construction Workers

This unit helps the construction workers for improving their management related skills required in the construction works. The contents included in this unit will be very useful for the construction supervisors to provide necessary work-based training exercises and conduct performance evaluations of workers towards the following elements of outcomes.

The workers will be able to

- follow the guidelines/procedures related to quality assurance and controlling practices in construction operations
- manage themselves to strengthen their financial background for personal life aspects
- follow the aspects of labour laws for career benefits

This unit provides necessary procedures, explanations and solution guidelines that need to be followed by the construction workers for the following questions.

- What are the guidelines/procedures related to quality assurance and controlling practices that I need to follow in my work operations?
- How to strengthen my financial background for my personal life aspects?
- What are the aspects of labour laws useful for my career benefits?

7.1 What are the guidelines/procedures related to quality assurance and controlling practices that I need to follow in my work operations?

I need to follow all the guidelines and procedures mentioned in previous sections to perform my work ensuring quality practices. It will make sure the required strength and durability of the construction as well as make it comfortable for the users. While I am involved in material handling, equipment handling, measuring and estimating work, I should ask the following questions to ensure quality outcomes.

- Material handling
  - Am I using the right material?
  - Is the size and shape of the material in an acceptable range?
  - Am I following the right procedures in working with materials?
- Equipment handling
  - Am I using the right equipment for the relevant operation?
  - Do I have the skills to operate the particular equipment?
  - Am I following the guidelines mentioned in the handbook/manual?
  - Am I working with the equipment to ensure safety aspects?
  - If the equipment is broken down, do I know how to repair it?
  - Are my practices right for the long usage and maintenance of the equipment?

- Measuring and estimating:
    - Am I using the appropriate units for the particular measurement?
    - Am I using the right tool for the particular measurement?
    - Is my measuring method appropriate?
    - Am I ensuring the accuracy of the measurement?

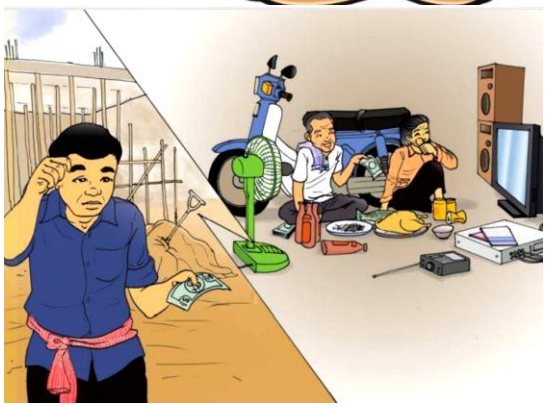
7.2 How to strengthen my financial background for my personal life aspects?

My life pattern towards my life goals mainly depends on my social and economic background. My daily activities should be planned considering my economic background and income at the current stage, and the expected future stages and needs. I should always ask myself the following questions to strengthen my financial background.

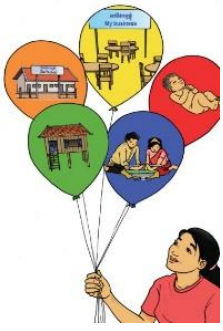
- Is my monthly income sufficient for fulfilling my needs at the current stage?
- Do I save a sufficient amount for future purposes/needs?

- Am I using the money for unnecessary/unimportant needs?
- How can I reduce my expenditure?
- Do I maintain proper records of my income and expenditure?
- Can I invest some money where I can get some profits?
- Am I doing the investment safely?
- Are my family members understanding my financial abilities?

I need to find ways to get promotion opportunities at my workplace. By developing my skills and performance, I can achieve it.



I should understand that I may need to face economic related problems at any time. To avoid it, I should strengthen my financial background in possible ways. When I manage my income and expenditure, I must adhere to controlling the expenditures based on the income. I must also be aware of future expenditures for some important purposes.



I must maintain the records of my income and expenses with proper monitoring for each month. The following table can be used for it.

Type of Income and Expenses	Amount	
Income		
Salary	xx.xx	
Overtime payments	xx.xx	
Arrears amount	xx.xx	
Bonus	xx.xx	
Others	xx.xx	
Total Income		**XXXXX.XX**
Expenses		
Food	yy.yy	
Accomodation	yy.yy	
Transport	yy.yy	
Health/Medical expenses	yy.yy	
Communication expenses	yy.yy	
Other utilities	yy.yy	
Others	yy.yy	
Total Expenses		**YYYYY.YY**
Saving (Total Expenses – Total Income)		**ZZZZZ.ZZ**

If I choose only the essential needs among the above-shown expenses, it is the best way for me to further strengthen my financial status.

I need to gain knowledge about the types of financial accounts, insurance facilities and other banking facilities that may help me to improve my financial background. I can get some advice and suggestions from the relevant advisors.

7.3 What are the aspects of labour laws useful for my career benefits?

The main elements of the labour rights are access to employment, freedom from forced labour and labour security. Other important components are:

- The freedom to work; freedom concerning the choice of occupation as well as the place of performance.
- The right to earn a living from work of one's own choice, encompassing the freedom to establish one's own independent form of employment.
- The right to free employment services; the right to work has been interpreted as the commitment of the state to undertake continuous efforts to ensure full employment. Such efforts include the formulation and implementation of employment promotion policies and the promotion of technical and vocational education programmes aimed at increasing employment, as well as free access to information and assistance for job seekers.

- The right to safe and healthy working conditions, as well as rest, leisure and reasonable working hours.
- The right to employment; the right not to be arbitrarily dismissed and the right to protection against unemployment.

This section contains the following information extracted from the labour legislations of the Department of Labour, Sri Lanka. Though these are fully applied to permanent government employees, some of these are practised by private firms as well.

Age

The minimum age for employment is 14 years in Sri Lanka. The workers are not allowed to join unions until the age of 16.

Working hours

Total working hours (exclusive of meals and rest) should not exceed 9 hours per day. It should not exceed 45 hours in any week. The employee shall claim overtime payment if the working hours exceed. The overtime hours in a week cannot exceed 12 hours. Working hours of a person above the minimum age of employment but less than 16 years shall not exceed 12 hours per day. It should also not be before 6 am and after 6 pm.

Minimum salary

The minimum monthly salary for all employees (from any industry) is LKR 10,000. The minimum daily salary is LKR 400. Overtime is paid at one and half times the average hourly rate of salary.

Payroll cycle

The salaries are paid on a daily, weekly, fortnightly or monthly basis. However, a salary period cannot exceed a month. The salary has to be paid on a working day.

Leaves

- An employee who works for not less than 28 hours (excluding overtime and rest breaks) in any one week must be allowed one and half days paid holiday in that week or the week immediately after that. This weekly holiday shall be provided as a half-day on Saturday and a full day on Sunday. Most organisations offer a full day's holiday on Saturday. Any employee required to work on a weekly holiday shall be entitled to payment at the overtime rate.
- An employee is entitled to 14 days of annual leave with full pay for every completed year of service. He/she is required to take seven days on a consecutive basis. In respect of the first year of employment, an employee is entitled to proportionate in the succeeding year leave calculated on the following basis:
  - 14 days' leave if work commenced on or after 1st of January but before 1st of April.
  - 10 days' leave if employment started on or after 1st of April but before 1st of July.
  - 7 days' leave if work commenced on or after 1st of July but before 1st of October.
  - 4 days' leave if employment began on or after 1st of October but before 1st of December.
- Employees are entitled with 7 days paid casual leave in any year, except during the first year of employment.

During the first year of employment, the employee is entitled to one day of paid casual leave for every two months working.

- A female employee can apply for 84 days of maternity leave. She cannot be dismissed based on her pregnancy or of any illness consequent to her pregnancy.
- Every worker certified by a doctor is entitled to sick leave for seven days a year.
- There is no provision for marriage leave, adoption leave, childcare leave and death leave. It is at the employer's discretion.
- If an employee is absent from work due to injury sustained during work and under the circumstances specifically attributed to the nature of his duties, he/she is granted accident leave. The employer shall also pay the employee following the terms and conditions of the insurance policies.
- All the workers are granted duty leave for the following purposes:
    - Any employee who is on the reserve list of a volunteer unit of armed forces.
    - To attend examinations with regards to language proficiency.
    - To attend any medical examination.
    - To cast votes for elections or referendums.

Employee provident fund and Employees' trust fund

The employers and employees contribute to the Employees' Provident Fund (EPF) and Employees' Trust Fund (ETF). The minimum contribution should be 8% by employees and 12% by employers in EPF, and 3% by employers in ETF.

Termination

The termination notice period is a minimum of one month.

Probation period

The probation period shall not exceed one year in the case of employees in supervisory or technical capacity and six months for any other employee. The employer may further extend in some cases for a maximum of 3 months.

Severance pays

Employees terminated by notice shall be entitled to severance payment, which is as follows:

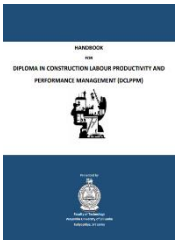
- 2.5-month pay per year of service for 1st to 5th year of service (maximum compensation: 12.5 months)
- 2-month pay per year of service for 6th to 14th year of service (maximum compensation: 30.5 months)
- 1.5-month pay per year of service for 15th to 19th year of service (maximum compensation: 38 months)
- 1-month pay per year of service for 20th to 24th year of service (maximum compensation: 40 months)
- 0.5-month pay per year of service for the 25th-34th year of service (maximum compensation: 48 months)

A SPECIAL NOTE

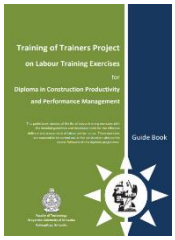
This book has been designed based on research conducted on the performance of construction workers, as mentioned in the preface of the authors. Notably, a set of construction supervisory workers are currently involved in the delivery of work-based training exercises and skill assessments at some selected construction sites based on the contents provided in this book. These construction supervisory workers are the students of the 'Diploma in Construction Labour Productivity and Performance Management (DCLPPM)' which is currently delivered by the Faculty of Technology of the Wayamba University of Sri Lanka.

For further information, the following handbooks/guidebooks are recommended to refer.

- Student Handbook for Diploma in Construction Labour Productivity and Performance Management (DCLPPM), Faculty of Technology, Wayamba University of Sri Lanka, Sri Lanka



- Guidebook of Training of Trainers Project on Labour Training Exercises for Diploma in Construction Productivity and Performance Management (DCLPPM), Faculty of Technology, Wayamba University of Sri Lanka, Sri Lanka



Faculty of Technology, Wayamba University of Sri Lanka, Sri Lanka offers

Diploma in Construction Labour Productivity & Performance Management (DCLPPM)

www.wyb.ac.lk/dclppm

Introduction of the Programme

Due to the essential need for skills development training programmes for the industry practitioners, this diploma programme has been designed for the construction supervisors / technical officers who directly apply the practices to construction operations. The programme specifies the competencies, knowledge and attitudes required by the construction industry for improving the performance and productivity of the workforce.

Implications of the Programme

The DCLPPM programme is expected to make an effective contribution to the economic and social development of the country by making provision for nationally consistent, technical and vocational education and training. It includes effective and innovative practices for productivity improvement in the industry through proactive education and training strategies. The outcomes of this diploma programme are expected to be highly contributing to the construction industry sector by upgrading their current practices with the direct concept of productivity and performance improvement.

Why is this diploma significant compared to other diploma programmes currently available in the Sri Lankan construction sector?

The DCLPPM is willing to be an ideal programme for the Sri Lankan construction sector. It meets the industry's needs and expectations. The curriculum of this diploma programme was systematically developed by the experts through an extensive investigation conducted in the Sri Lankan construction industry with the direct scope of improving the performance and productivity of the construction workforce. The DCLPPM includes outcome-based teaching, learning and assessments with relevant quality assurance practices. The academic activities of this programme will be delivered by university lecturers and qualified engineering experts from the industry. The most significant part of this diploma programme is the inclusion of labour training exercises in the Training of Trainers Project. This will enable the course followers to train workers in the construction sites through demonstrations, guidelines and other relevant activities/tasks. Training of Trainers Project Guide Book will be delivered among the course followers at the beginning of the programme.

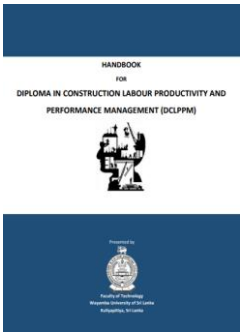
Benefits highlighted to the

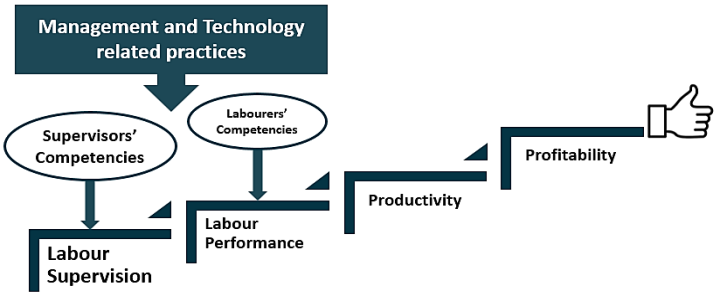
Course followers

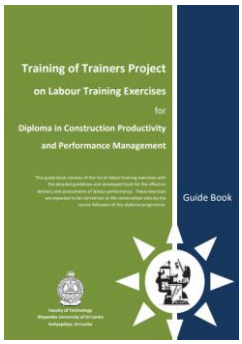
- SLQF 3 / NVQ 5 qualification certification completion within one year (part-time) and the clear path for future career development
- Opportunity to involve with modern technologies and innovative practices
- Labour training experience, recognition and certification
- Opportunity to become as NVQ Assessors
- Opportunity to receive 'Best Labour Trainer Award' and 'Labour Trainer Merit Awards'

Construction firms

- Systematic procedure for labour skills assessments and rewarding mechanisms at the construction sites
- Effective practices using a well-developed performance score system and worker grading scheme
- Productivity measurements and performance assessments practices
- Productivity improvement with the evidence and the way to profitability







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