COMPETENCY-BASED LEARNING MATERIALS

SECTOR: **CONSTRUCTION**
QUALIFICATIONS: **HEAVY EQUIPMENT OPERATION (FORKLIFT) NC II**
UNIT OF COMPETENCY: **PERFORM PRE AND POST- OPERATION PROCEDURES FOR FORKLIFT**
MODULE TITLE: **PERFORMING PRE AND POST- OPERATION PROCEDURES FOR FORKLIFT**
INSPIRE ACADEMY INC. Jumbo highway Punta Tabuc, Roxas City, Capiz

Competency-Based Learning Materials

Perform Pre and Post- Operation Procedures for Forklift

	Heavy Equipment Operation (Forklift) NC II	Date Developed: October 2025	Document No.	
			Issued by:	
	Perform Pre and Post-Operation Procedures for Forklift	Developed by: Inspire Academy Inc.	Revision No.001	

Printed by:
INSPIRE ACADEMY INC.

October 2025

For further information, please contact

The Head-Office of the Academic Affairs
Inspire Academy Inc.
Jumbo highway Punta Tabuc,
Roxas City, Capiz
Mobile No.: (09)07 981 8909
Tel. No.: (036) 620 7226
Email Add: inspireacademy.ph@gmail.com

HOW TO USE THIS COMPETENCY BASED LEARNING MATERIALS

Welcome to the module in Forklift Operation NC II. This module contains training materials and activities for you to complete.

The unit of competency **"PERFORM PRODUCTIVE OPERATION FOR FORKLIFT OPERATION "** contains knowledge, skills and attitudes required for a trainer course. It is one of the specialized modules in Forklift Operation NC II.

You are required to go through a series of learning activities in order to complete each learning outcome of the module. In each learning outcome are Information Sheets and Resources Sheets (Reference Materials for further reading to help you better understand the required activities). Follow these activities on your own and answer the self-check at the end of each learning outcome. You may remove a blank answer sheet at the end of each module (or get one from your facilitator/trainer) to write your answers for each self-check. If you have questions, don't hesitate to ask your facilitator for assistance.

You may already have some or most of the knowledge and skills covered in this learner's guide because you have: been working for some time already completed training in this area.

If you can demonstrate to your trainer that you are competent in a particular skill or skills, talk to him/her about having them formally recognized so you don't have to do the same training again. If you have a qualification or Certificate of Competency from previous trainings, show it to your trainer. If the skills you acquired are still current and relevant to the unit/s of competency they may become part of the evidence you can present for RPL. If you are not sure about the currency of your skills, discuss this with your trainer.

This module was prepared to help you achieve the required competency in DRIVING LIGHT VEHICLE. This will be the source of information for you to acquire knowledge and skills in this particular trade independently and at your own pace, with minimum supervision or help from your instructor.

Talk to your trainer and agree on how you will both organize the Training of this unit. Read through the module carefully. It is divided into sections, which cover all the skills, and knowledge you need to successfully complete this module.

Work through all the information and complete the activities in each section. Read information sheets and complete the self- check. Suggested references are included to supplement the materials provided in this module.

Most probably your trainer will also be your supervisor or manager. He/she is there to support you and show you the correct way to do things.

Your trainer will tell you about the important things you need to consider when you are completing activities and it is important that you listen and take notes.

You will be given plenty of opportunity to ask questions and practice on the job. Make sure you practice your new skills during regular work shifts. This way you will improve both your speed and memory and also your confidence.

Talk to more experience workmates and ask for their guidance.

Use the self-check questions at the end of each section to test your own progress. When you are ready, ask your trainer to watch you perform the activities outlined in this module.

As you work through the activities, ask for written feedback on your progress. Your trainer keeps feedback/ pre-assessment reports for this reason. When you have successfully completed each element, ask your trainer to mark on the reports that you are ready for assessment.

When you have completed this module (or several modules), and feel confident that you have had sufficient practice, your trainer will arrange an appointment with registered assessor to assess you. The results of your assessment will be recorded in your competency Achievement Record.

INSTRUCTIONAL SHEETS:

- Information Sheet – This will provide you with information (Concepts, principles and other relevant information) needed in performing certain activities.
- Operation Sheet – This will guide you in performing single task, operation process in a job.
- Job Sheet – This is designed to guide you how to do the job that will contribute to the attainment of the learning outcome.
- Assignment Sheet – The assignment sheet is a guide used to enhance (follow up) what you have learned in the information sheet or job sheet.
- Worksheet – are the different forms that you need to fill up certain activities that you performed.

LIST OF COMPETENCIES

NO.	UNIT OF COMPETENCIES	MODULE TITLE	CODE
1	**Perform pre and post- operation procedures for forklift**	**Performing pre and post- operation procedures for forklift**	**CON8342 16**
2	Perform basic preventive maintenance servicing for forklift	Performing basic preventive maintenance servicing for forklift	CON834 217
3	Perform productive operation for forklift	Performing productive operation for forklift	CON834 218

MODULE CONTENT

UNIT OF COMPETENCY: Perform Productive Operation for Forklift Operation

MODULE TITLE: Performing Productive Operation for Forklift Operation

MODULE DESCRIPTOR: This module covers the knowledge for skills and attitude required in the productive operation of Forklift.

NOMINAL DURATION: 72hours

QUALIFICATION LEVEL: NC II

SUMMARY OF LEARNING OUTCOMES

Upon completion of this module, the trainee would be able to:

LO 1. Check operational area. LO 2. Identify types of cargoes
LO 3. Perform load handling operation

ASSESSMENT CRITERIA

1. Safe loading and unloading procedures is performed
2. Work assignment/instruction is secured.
3. Hazards in the Work area identified
4. Barriers or safety signage are checked in area.
5. Classification/specification of cargoes are identified
6. Handling procedure is determined according to cargo specification
7. Forklift is properly positioned towards the load based on job requirements.
8. Load center is observed according to lifting capacity.
9. Fork ground safe clearance and carriage position are maintained/observed during traveling.
10. Forklift is driven in proper direction to achieve safe handling of materials.
11. Loads/Cargoes are carefully handled in the storage facilities in accordance with load/cargo classifications/specifications.
12. Operational hazards are identified and/or anticipated and avoided through appropriate hazard control.
13. Unexpected situations are responded in line with company rules and regulations in a manner that minimizes risk to workers and equipment

LEARNING OUTCOME #1	CHECKING OPERATIONAL AREA
CONTENTS	Recommended practices in loading and unloading of forklift
ASSESSMENT CRITERIA	• Safe loading and unloading procedures is performed • Work assignment/instruction is secured. • Hazards in the Work area identified • Barriers or safety signage are checked in area.
CONDITIONS	Students/Trainees must be provided with the following: • Operations and maintenance manual • Unit of Equipment (Forklift) • Personal Protective Equipment • Classroom for discussion • Video CD's • Handouts Workplace
METHODOLOGIES	• Demonstration • Self-paced • Classroom discussions • Video presentation
ASSESSMENT METHOD	• Direct observation • Written test/questioning

LEARNING EXPERIENCES

Learning Outcome No. 1	Check Operational Area.
Learning Activities	Special Instructions
Read Information sheet 3.1-1 on recommended practices in loading and unloading of Forklift	Use Information sheet 2.1-1 on recommended practices in loading and unloading of Forklift
Answer Self-Check 3.1-1	Check your answer using Answer Key 3.1-1

INFORMATION SHEET 3.1-1
RECOMMENDED PRACTICES IN LOADING AND UNLOADING OF FORKLIFT

Moving goods around your warehouse or depot and storing them in a well-organized way can be a major challenge. But abiding by correct forklift safety procedures will ensure that when loading and unloading heavy items, everything runs smoothly and efficiently and without causing any harm or damage.

If operators fail to abide by the correct procedures, it could lead to queuing, inefficiency, increased costs and injury to operators and others, as well as damage to goods and equipment. Having trained staff that follow the right forklift safety procedures is therefore essential to your materials handling operations.

At Cat® Lift Trucks, not only do we take safety into account when designing our materials handling equipment, but also consider how the people operating them need to perform their tasks. Below are our top tips for loading and unloading your forklift trucks safely.

Before loading your forklift truck:

- Keep in mind that forklifts are for carrying loads and nothing else.
- Be aware of your surroundings and observe all signs, especially those for maximum permitted floor loadings and clearance heights, and check for any overhead objects before lifting or stacking loads.
- The load should be carefully checked to ensure it's suitable, undamaged and stable for the forklift – avoid lifting anything that isn't safe or firm enough to do so.
- Make sure the load is carefully and correctly positioned on the pallet or skid - evenly distributed, safe and secure to avoid it collapsing whilst on the forklift.
- Only use pallets and skids that can withstand the weight of the load and check that there are no damaged, deformed or decaying pallets holding the loads.
- Ensure the ground is flat - never load or unload your forklift on a ramp or uneven surface and check the floor can support the combined weight of the forklift and the load.
- If loading or unloading from a lorry, check that the brakes of the vehicle are set up to stop it moving or that chocks are in place. Our EP14-20A(C)N(T) 48V truck range comes with Presence Detection System+ which includes automatic parking brake, hill hold and – if operator is not seated – prevention of travel and hydraulic movement, to ensure safety in loading situations.
- Check that the height of the vehicle's entrance door clears the forklift height by at least 5 cm (2 in.).

How to load your forklift:

- While loading, ensure the goods are evenly distributed, correctly stacked and positioned across both forks to avoid any collapsing and damage to the contents. Do not lift a load with one fork.
- Ensure the load is fully secure before moving the forklift. Use securing measures such as ropes or bindings if needed.
- Never overload a forklift truck as it's an accident waiting to happen. Know the capacity of your forklift and any attachments being used and never exceed this capacity. An overloaded vehicle can cause the rear tyres to be raised off the ground and may cause the forklift to tip over.
- Do not use the tip of the forks as a lever to raise a heavy load or push a load with the tip of the forks.
- It is important to ensure that the goods are tilted back with the forks sitting low whilst transporting in order to increase truck stability. Keep the centre of gravity of the load as low to the ground and as close to the front wheels as possible: Carry the load at the lowest position possible, 4 - 6 inches from the ground. Tilt the mast back and position the heaviest part of the load against the carriage.

Unloading your forklift:

- Inspect the load before unloading to make sure the goods have not shifted during transit and are not likely to move or fall when any restraints are removed. If the load has moved in anyway, consider how it can be unloaded safely.
- The area where the unloading is to take place must be suitable for this to be done safely. Check for hazards, such as obstructions in the unloading area, firmness and support of ground or any pedestrians before unloading.
- Ensure the brakes are set and the forklift that you're unloading isn't going to move suddenly during the procedure. We've specifically designed our EP14-20A(C)N(T) 48V truck range with a Presence Detection System+ which includes automatic parking brake, hill hold and – if operator is not seated – prevention of travel and hydraulic movement
- Line the pallet up with the place that you want to put the load; make sure the load is as level as possible; lower to the right height, enter the load slowly and always listen and look out to see if it's scraping or hitting anything. Then line the pallet up with the racks, lower the load and ease the load in as smoothly as possible; lower the forks slightly and then reverse straight back out of the way and lower the forks down.

Cat® Lift Trucks offers a comprehensive range of powerful and efficient forklift trucks for every loading and unloading situation and to suit any application. Whether you are looking to move goods around a narrow aisled warehouse or a large spacious shipping depot, we offer the ideal solution. Our counterbalance forklift trucks, order pickers, stackers and reach trucks are equipped with the ideal drive types for your needs – be it diesel/LPG, electric or manual and allow a range of load weights to be lifted.

For more tips on using your forklift safely, check out our forklift safety guide video features top right.

Image:
How should you prepare the work area before using a forklift truck for the loading or unloading operation?

Back to top

For example, when loading or unloading a transport trailer:

- Make sure that the transport vehicle's brakes are engaged.
- Ask the driver to turn off the vehicle's motor to reduce exposure to exhaust fumes.
- Chock the vehicles' wheels.
- Engage a trailer restraint system, if available, as the restraint can help prevent the trailer from separating from the loading dock.
- If loading or unloading a flatbed trailer, make sure that it is parked on a level surface that is free of debris, depressions, mounds, and unstable ground.

- Instruct the vehicle's driver to stay clear of the loading and unloading area while forklift is in motion.
- Make sure that the trailer's landing gear or stabilizer is fully supporting the trailer if it is not coupled to a vehicle.
- Post signs warning not to move the vehicle.
- Check that there is sufficient clearance between the forklift (including the load when raised) and the trailer's roof.
- Make sure the trailer's deck can support the combined weight of the forklift and the load.
- Inspect the interior of the trailer for trash, loose objects and obstructions, holes or weak flooring, poor lighting, liquid spills, low overhead clearance, etc.
- Do not load or unload in adverse weather conditions.
- Choose the forklift with the most appropriate features for the conditions (e.g., enclosed cabin for cold weather, pneumatic tires for outdoor loading/unloading, onboard lights, etc.).
- Make sure that docks and dock plates are in good working condition, clear of obstructions, and not oily or wet.
- Make sure that the dock plate is properly positioned, levelled, secured, and can support the weight of the load and forklift before driving over it. The dock plate load weight should be clearly marked.

What should you do while loading and unloading with a forklift truck?

- Sound horn when entering and exiting trailers or bays.
- Be alert for other vehicles, pedestrians, and materials around you.
- Continuously evaluate the status of the trailer, dock plate, and forklift. Stop loading or unloading if conditions become unsafe (e.g., trailer tilts, gap forms between the trailer and the dock; forklift becomes difficult to steer, etc.).
- Evaluate each load before each lift. Do not lift unstable or unsuitable loads (e.g., leaning or improperly secured loads, loads sitting on damaged skids, etc.).

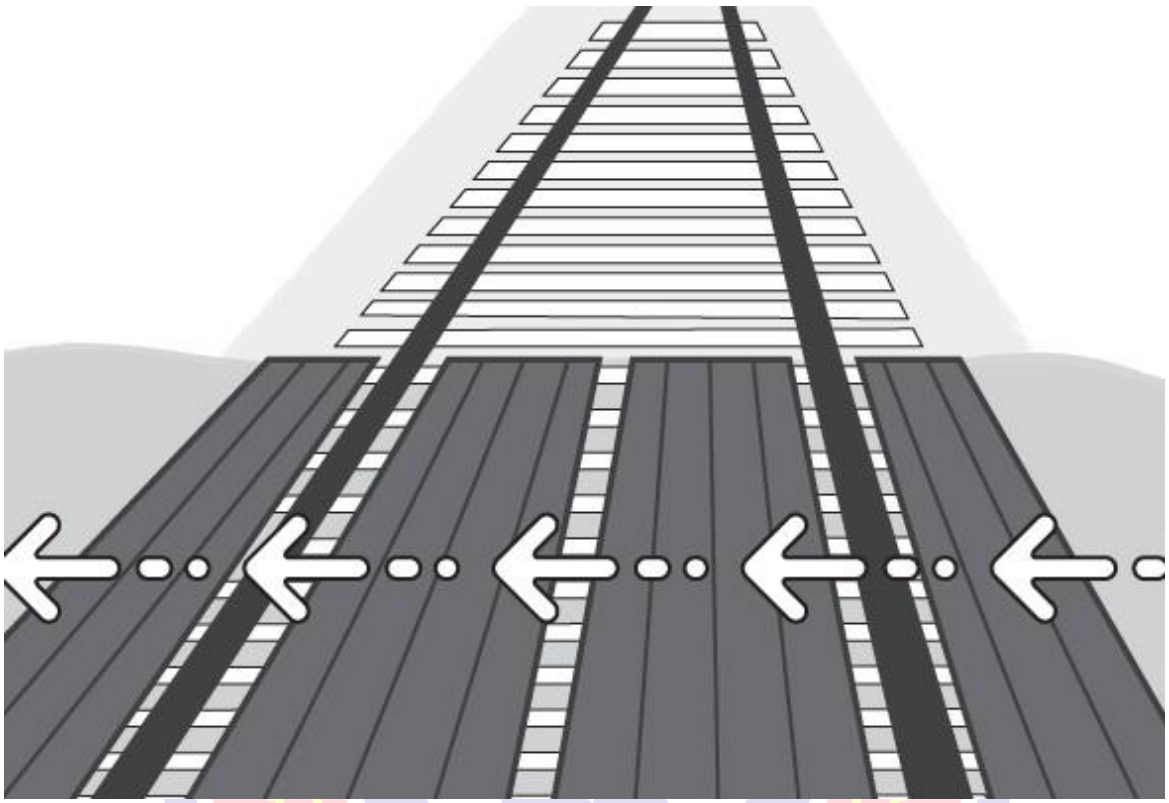
- Use the proper technique when loading and unloading to prevent tipping the trailer/vehicle (i.e., keep the load balanced on the trailer, railcar, etc.).
- Keep forks pointed downhill when travelling without a load on a ramp.
- Keep forks pointed uphill when travelling with a load on a ramp.

- Stay clear of edges of docks, rail cars or ramps.
- If the forklift is gas or propane powered, do not operate forklifts inside vehicles for long periods without ventilation.
- Drive slowly and carefully to avoid damaging the forklift or trailer, alter the alignment of the dock plate with the trailer, shift the weight distribution of the trailer enough to cause a tip over.

When using forklifts around railway tracks and loading railcars, what is important to know?

- Cross railway tracks on a diagonal at designated locations only.

- Make sure that handbrakes, wheel blocks and derailer are set before entering a railcar.
- Do not park a forklift within three meters of railway tracks or inside railcars.
- Do not tow or push railcars or trucks with a forklift.
- Do not open railway car doors with forklift forks .



SELF-CHECK 3.1-1

Enumeration: When using forklifts around railway tracks and loading railcars, what is important to know?

ANSWER KEY 3.1-1

- Cross railway tracks on a diagonal at designated locations only.
- Make sure that handbrakes, wheel blocks and derailer are set before entering a railcar.
- Do not park a forklift within three meters of railway tracks or inside railcars.
- Do not tow or push railcars or trucks with a forklift.
- Do not open railway car doors with forklift forks

LEARNING OUTCOME #2	IDENTIFY TYPES OF CARGOES
CONTENTS	Types of cargoes Safe handling procedures according to cargo requirements
ASSESSMENT CRITERIA	• Classification/specification of cargoes are identified • Handling procedure is determined according to cargo specification
CONDITIONS	Students/Trainees must be provided with the following: • Operations and maintenance manual • Unit of Equipment (Forklift) • Personal Protective Equipment • Classroom for discussion • Video CD's • Handouts Workplace
METHODOLOGIES	• Demonstration • Self-paced • Classroom discussions • Video presentation
ASSESSMENT METHOD	• Direct observation • Written test/questioning

LEARNING EXPERIENCES

Learning Outcome No. 2	Check Operational Area.
Learning Activities	Special Instructions
Read Information sheet 3.2-1 on Recommended practices in loading and unloading of Forklift	Use Information sheet 2.2-1 on Recommended practices in loading and unloading of Forklift
Answer Self-Check 3.2-1	Check your answer using Answer Key 3.2-1
Read Information sheet 3.2-2 on Safe handling procedures according to cargo requirements	Use Information sheet 2.2-2 on Safe handling procedures according to cargo requirements
Answer Self-Check 3.2-2	Check your answer using Answer Key 3.2-2

INFORMATION SHEET 3.1-1
TYPES OF CARGOES

Types of cargo

For selection of the optimal transportation method, cargoes are divided into certain groups and categories. Based on their physical properties in the transport classification, cargoes are divided into liquid, loose (dry cargo) and live cargoes. Each category has a subgroup that includes the goods and products similar by transport characteristics and transportation conditions required for their safety. There are the following types of cargo:

- liquid (liquid food products, chemical substances, oil products, liquefied gas) cargo;
- loose or bulk cargo;
- general cargo (packed/unpacked goods in batches and single pieces);
- condition products (perishable, requiring ventilation, etc.);
- hazardous cargo (explosives, highly inflammable substances and products, poisons, radioactive materials, etc.);
- valuable goods;
- oversized and super-heavy cargo;
- long cargo, etc.

Rules of air transportation of cargo

Transportation of all types of cargo by aircrafts shall be carried out in accordance with the special regulations.

Transportation of hazardous cargoes by airliners shall be carried out as per the Federal Aviation Regulations, which are called “Safe Air Transportation of Hazardous Cargoes and Weapons”. This set of rules regulates the following:

- hazard classes (9);
- requirements to packaging, fastening and labeling;
- proper documentation;
- Availability of additional fire-extinguishing or neutralization means, etc.

As per the regulations, the incompatible cargoes shall not be transported together. Moreover, the hazardous cargoes are often transported without transshipments.

In compliance with the regulatory documents, all types of cargo transported by air must have:

- Dry and clean packaging or tare, corresponding to their type;
- The weight and dimensions must not exceed the established standards (otherwise the carrier shall decide on transportation).

The following rules apply in case of international transportation:

- Transported goods must be allowed for import/export;
- Dimensions of the transported cargo must enable free handling,
- Detailed and exact documentation of cargoes in accordance with the established requirements;
- Transported goods must not constitute a hazard to aircraft, crew and passengers

SELF-CHECK 3.2-1

Enumeration: what are the classifications of cargoes

ANSWER KEY 3.2-1

- liquid (liquid food products, chemical substances, oil products, liquefied gas) cargo;
- loose or bulk cargo;
- general cargo (packed/unpacked goods in batches and single pieces);
- Condition products (perishable, requiring ventilation, etc.);
- Hazardous cargo (explosives, highly inflammable substances and products, poisons, radioactive materials, etc.);
- valuable goods;
- oversized and super-heavy cargo;
- long cargo

INFORMATION SHEET 3.2-2
SAFE HANDLING PROCEDURES ACCORDING TO CARGO REQUIREMENTS

Best Practices for Loading and Unloading Heavy Cargo

1. Ensure that the loading area has good lighting at all times. The loading area should also be away from both vehicles and pedestrians.
2. Ensure that the loading area is firm, flat, clean, and free from potholes and other obstructions that may cause slips or trips.
3. Inspect the vehicle and make sure that horns, reflectors, lights, and other safety features are in good condition.
4. Provide guards for dangerous parts of the vehicle, such as chain drives, power take-off devices, and exposed exhaust pipes.
5. Before loading or offloading transport, ensure that the vehicle is braked and stabilized.
6. Clean out any junk or loose materials (crates, cables, wires, chains, and bins) in the vehicle before loading tools or equipment.
7. When securing cargo in the vehicle, one tie-down must be used for every 10 feet of cargo. Make sure to use at least two tie-downs for any cargo regardless of its length.
8. Use a red flag to mark loads that extend more than three feet beyond the body of the vehicle. When transporting cargo at night, use a red light instead of a flag.
9. Use at least four binders for loads like pipes and logs that are 27 feet long. Ensure that the spacing between binders is equal.
10. Never load unsecured items on the back seat or rear window deck of the vehicle. This can cause the load to hit passengers or the driver when the vehicle comes to a sudden stop.
11. As much as possible, use a compartment or toolbox to keep small items secure in a vehicle. If this is not feasible, use a tarp to cover the small items, making sure that it is securely tied down with ropes or straps.
12. When on the road, stop frequently to check your cargo. This is even more necessary when traveling long distances.

SELF CHECK 3.2-1

True or False: Carefully read each questions below and write **True** if the statement is correct and **False** if the statement is incorrect

1. Before loading or offloading transport, ensure that the vehicle is braked and stabilized.
2. Clean out any junk or loose materials (crates, cables, wires, chains, and bins) in the vehicle before loading tools or equipment.
3. When securing cargo in the vehicle, two tie-down must be used for every 10 feet of cargo. Make sure to use at least two tie-downs for any cargo regardless of its length.
4. Use a red flag to mark loads that extend more than three feet beyond the body of the vehicle. When transporting cargo at night, use a red light instead of a flag.
5. Use at least four binders for loads like pipes and logs that are 27 feet long. Ensure that the spacing between binders is equal.

ANSWER KEY 3.2-2

1. True
2. True
3. False
4. True
5. True

LEARNING OUTCOME #3	Perform Load Handling Operation
CONTENTS	Forklift truck dynamics General precaution and safety
ASSESSMENT CRITERIA	Forklift is properly positioned towards the load based on job requirements. • Load center is observed according to lifting capacity. • Fork ground safe clearance and carriage position are maintained /observed during traveling. • Forklift is driven in proper direction to achieve safe handling of materials. • Loads/Cargoes are carefully handled in the storage facilities in accordance with load/cargo classifications/specifications. • Operational hazards are identified and/or anticipated and avoided through appropriate hazard control. • Unexpected situations are responded in line with company rules and regulations in a manner that minimizes risk to workers and equipment.
CONDITIONS	Students/Trainees must be provided with the following: • Operations and maintenance manual • Unit of Equipment (Forklift) • Personal Protective Equipment • Classroom for discussion • Video CD's • Handouts Workplace
METHODOLOGIES	• Demonstration • Self-paced • Classroom discussions • Video presentation
ASSESSMENT METHOD	• Direct observation • Written test/questioning

LEARNING EXPERIENCES

Learning Outcome No. 3	Perform load handling operations.
Learning Activities	Special Instructions
Read Information sheet 3.3-1 on Recommended practices in loading and unloading of Forklift	Use Information sheet 2.3-1 on Recommended practices in loading and unloading of Forklift
Answer Self-Check 3.3-1	Check your answer using Answer Key 3.3-1

INFORMATION SHEET 3.31 FORK LIFT TRUCK DYMANICS

Dynamic load model for fork-lift trucks

Abstract

Long-span warehouse floors can suffer problematic vibrations due to dynamic interaction with moving fork-lift trucks. However, the dynamic loads caused by trucks are poorly understood and no mathematical model of these loads suitable for use in a dynamic analysis has previously been proposed. This paper presents a two-degree-of-freedom dynamic load model of a fork- lift truck suitable for use in an analytical floor vibration assessment. The load model comprises two time-varying vertical forces that are a fixed distance apart. Each force is the product of a mass matrix and a vertical acceleration vector, which is in turn a function of the horizontal velocity of the truck. The model derivation is partly analytical and partly experimental, with some key parameters derived from field tests on four fork-lift trucks in a total of twelve configurations. Data for general models are presented for a range of truck capacities from 1000 kg to 6000 kg. The model fills a significant gap in the current state of the art of vibration analysis, enabling a realistic assessment of fork-lift truck-induced floor vibrations to be performed using a finite- element program.

Introduction

In design codes, e.g. the Eurocode EC 1 [1] and the German DIN 1055 [2], the loads from fork-lift trucks are generally considered quasi-statically: the static weight of a truck is multiplied by a dynamic load factor (DLF) and the resulting load is applied statically to the structure in the design process. This approach has the benefit of simplicity, and it is assumed that the dynamic load factor will result in deformations and stress levels comparable to those that would result from a full dynamic analysis. It was noted some time ago [3] that these DLFs are generally not based upon well-defined mechanical considerations or systematic experiments and that information on dynamic forces from fork-lift trucks is limited or non-existent [4].

As modern structures are built with higher slenderness ratios and increasing vulnerability to vibrations, there is some evidence that the DLF approach to fork-lift truck loading is unsatisfactory. For example, Ehland [5] has noted vibration problems due to fork-lift truck traffic in precast composite floors used in industrial facilities. Such floors typically have a first mode in the region of 5 Hz, reducing with the initiation of cracks and the time-dependent effects from creep and shrinkage to around 3.7 Hz [6]. The problems are exacerbated by the low inherent damping of prestressed concrete structures [7].

A need therefore exists to investigate fully the dynamic interaction of a moving fork-lift truck and a slender, low-frequency floor system, so as to develop a more rigorous

and reliable method of serviceability assessment. As part of this project a simple, but realistic, dynamic load model of a fork-lift truck is required.

There is very little published research on the interaction of fork-lift trucks with structures. Eriksson [4] presented an estimated power spectral density plot for a single fork-lift truck, with a peak at 6.7 Hz, reducing to 6.4 Hz when a payload is carried. He found that the forces due to a loaded truck are smaller than from the unloaded truck due to a lower driving speed. He created a simple, single-degree-of-freedom model that takes the roughness of the surface into account.

Dynamic studies have been undertaken in support of the design of the fork- lift trucks themselves. For example, Beha [8] evaluated dynamic amplification factors for the design of various parts of fork-lift trucks, but results were reported only for the maximum speed. Lemerle et al. [9] presented a method to design suspended cabs for fork-lift trucks, based on a main excitation frequency of 6 Hz.

Other studies have focused on the health assessment of drivers. While these do not contain sufficient data to allow a load model to be derived, they report truck vibration frequencies of 3–6 Hz [10], 3–4 Hz [11], and 6 Hz [9], and vertical accelerations of the truck body of the order of 5 m/s2 [9], [10]. However, researchers generally did not consider the influence of velocity on the vibration amplitude [12].
This paper addresses the current lack of a load model suitable for dynamic structural assessments. Based on a modal analysis of a truck, a simple two- degree-of-freedom load model is introduced. Experiments on different trucks are then presented to validate the model and to establish a relationship between the vertical accelerations and the horizontal velocity.

Section snippets
Characteristics of fork-lift trucks

Fork-lift trucks used for indoor goods handling share some construction details across all manufacturers. To balance a large payload on the forks, the body of the truck is heavy and effectively rigid, with a large concentration of mass towards the rear axle. The axles are directly connected to the chassis and no spring–damper suspension system exists. The flexibility and damping of the truck come from the deformability of the solid rubber tyres (models fitted with pneumatic tyres are rare).

Frequencies and mode shapes

First, the experimental data were analysed for their frequency contents to validate the assumption that the excitation frequencies in the load model are the natural frequencies of the trucks.

The frequency content of the time domain signals was determined using standard signal analysis methods. Signals were low-pass filtered to remove frequencies above 100

Hz, and then split into 5 s intervals, with a 50% overlap. A Hamming window was applied to each interval and the fast Fourier transforms (FFT)

Summary of load model and typical parameters

The 2DOF load model has now been completely defined. The front and rear axle forces are related to the corresponding vertical accelerations by Eq. (5), with the accelerations expressed as a modal combination, Eq. (8). The required amplitude function is given by Eq. (11) or (12), according to local conditions, and the modal amplitude ratio is taken as a fixed value of 0.5.

The other parameters required are constants relating to the truck, and they can be obtained (or calculated) from

Field test

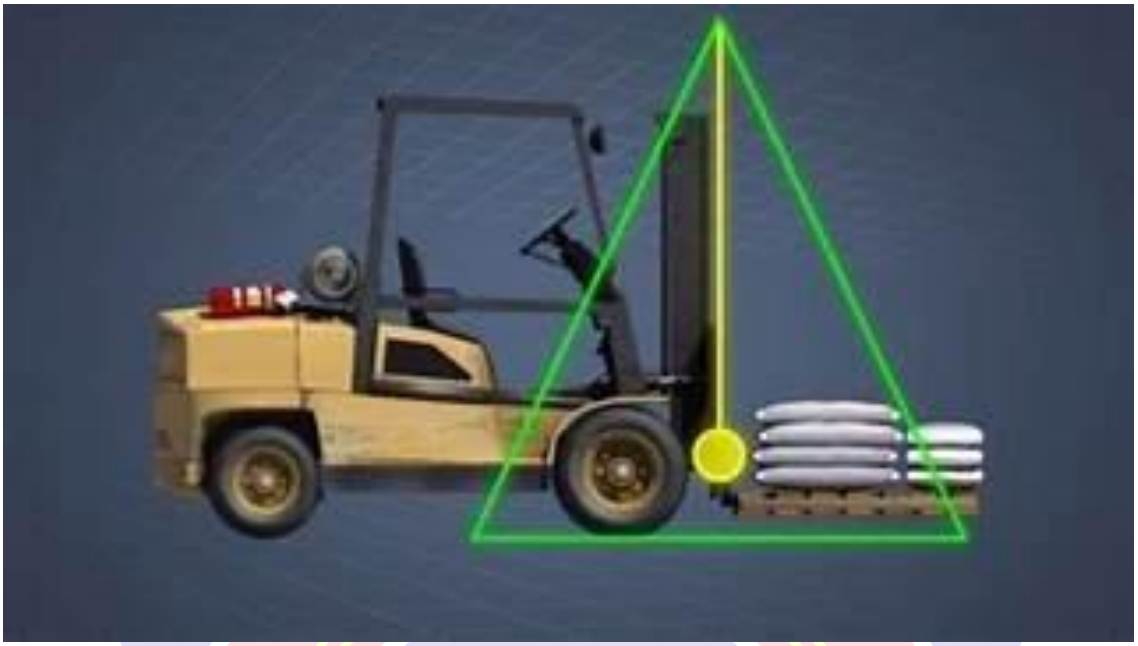
As a further verification of the model, a field test was undertaken on a suspended warehouse floor in Helmstadt, Germany. The floor comprised precast, partially prestressed double-T beams laid side by side and joined by an in situ structural concrete topping. The fundamental natural frequency was measured as 3.9 Hz.

Testing was performed by driving a Mariotti Mycros 13C fork-lift truck both parallel and perpendicular to the main floor beams. The truck's properties are given in Table 5. The field

Conclusions

A model of the vertical dynamic loads on a floor due to a fork-lift truck has been developed, filling a significant gap in current dynamic analysis capabilities. The model is simple, but realistic, as it can represent the major effects during motion well. It is based on published specifications of the fork- lift truck, experimentally determined natural frequencies, the power ratio of these frequencies and the relation between velocity and amplitude of vibration ((). The Model has been validated

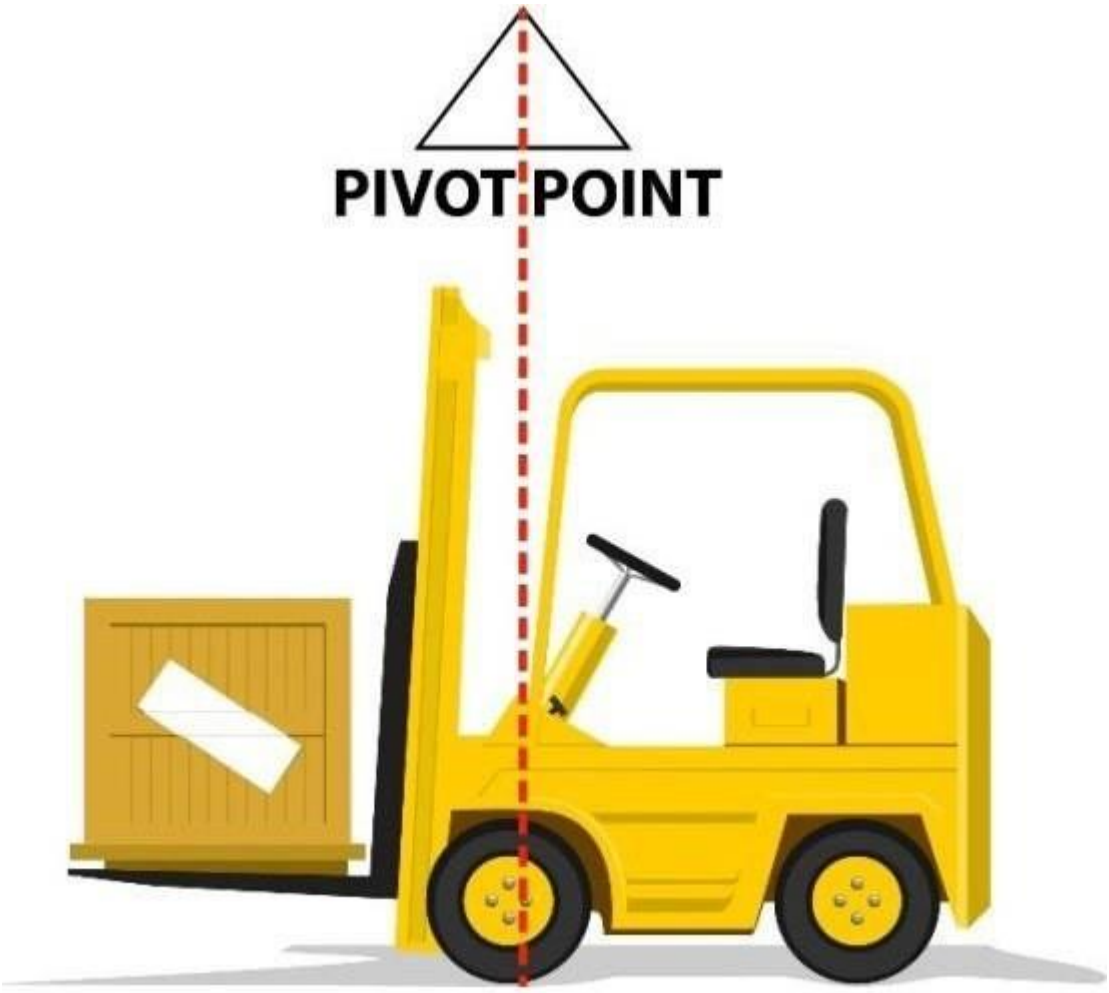
The Forklift Stability Triangle's Importance
By: BigRentz on August 16, 2022



Understanding the forklift stability triangle is essential for workplace safety. When workers understand their vehicle's capacity limits and the general principle of the stability triangle, they can operate safely on the job and reduce the risk of hazardous incidents. The guide breaks down the details of the forklift stability triangle and what you can do to ensure that your forklift is stable during material handling and won't create a safety hazard for you and your crew.

What Is the Forklift Stability Triangle?

The forklift stability triangle is an invisible triangle formed by the pivot point on the rear axle and the two front wheels joined by the front axle. As long as the center of gravity of the load is within this stability triangle, the forklift truck will not tip over. If you compromise the stability triangle, such as when your forklift carries too much weight at the front, you can cause the forklift's center of gravity to shift too far forward and eventually tip dangerously.



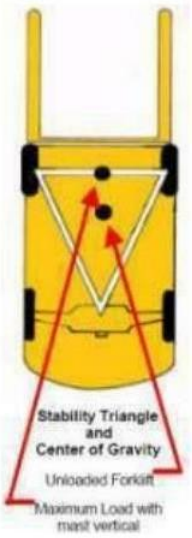
You should understand these helpful terms related to the stability triangle: Lateral stability: A lift truck's resistance to overturning sideways

Longitudinal stability: A lift truck's resistance to overturning forward or rearward
Dynamic stability: The idea that an unloaded or loaded forklift can shift due to sudden stops, starts, turns or tilts

Line of action: An imaginary vertical line through an object's center of gravity Load center: The horizontal distance from the forklift's line of action through the load's center of gravity

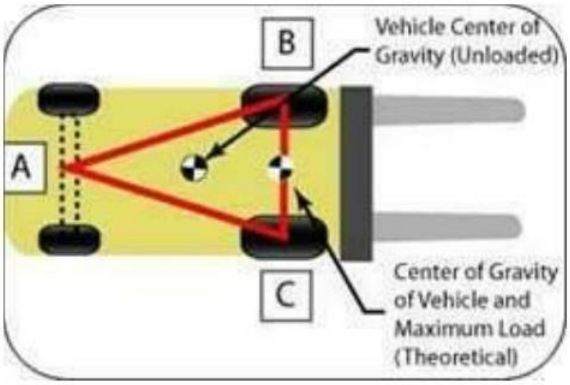
What Determines the Stability of a Forklift?

Three main factors govern the stability of a forklift: the size of the load, the terrain on which it is operating, and what type of forklift you are using.



Forklift Stability Triangle

OSHA



Almost all counterbalanced powered industrial trucks supported at three points. This is true even if the vehicle has four wheels. The truck's steer axle is attached to the truck by a pivot pin in the axle's center. When this point is connected to the front wheels with imaginary lines, this three-point support forms a triangle called the stability triangle. So long as the center of gravity remains within this stability triangle, the truck is stable and will not tip over.

The Load Size

When it comes to loads, you should consider both the size and distribution of that heavy load. Each forklift will have a specifically defined load capacity you should adhere to that will describe both of these factors. For example, a forklift may be rated to carry 4,000 pounds at 24 inches load center, but just 2,666 pounds at 36 inches load center. Never exceed the capacity of the forklift described on its data plate or name plate or you risk tipping.

The Terrain

The terrain on which the forklift operates also impacts its stability, as slippery and uneven surfaces can risk tipping the vehicle even if it is not exceeding load limits. Forklift operators should avoid traveling on oil, water, or other spills due to the risk of skidding. They should also avoid steep inclines and declines, or generally uneven surfaces. Finally, forklift operators should be aware of obstructions, holes, and speed bumps that can also cause the vehicle's wheels to elevate.

The Type of Forklift

You can use many different types of forklifts, and each has its own stability profile. If you're in the market for a forklift, carefully examine the specs on forklifts to determine which is the right one for your job.

Although you can find several types of forklifts, each forklift is best suited for a particular job. For example, you wouldn't want to use a forklift meant for smaller tasks to do heavy-duty warehouse lifting. Or, if you need long objects moved like pipes and timber, you'd want a forklift ideally suited for that job, such as a side loader.

Tips to Improve Forklift Stability

Proper safety training is key to forklift stability, and you can improve the stability of your forklift to minimize the risks of tipping. Keep in mind these are general tips: check your forklift safety manual for more safety instructions.

Keep the load low to the ground

The higher the load is, the more unstable it becomes, so keep the load as low to the ground as possible. Ideally, you want the load to be just 4 to 6 inches from the ground. OSHA recommends tilting the mast back and positioning the heaviest part of the load as close to the carriage as possible, keeping your center of gravity from shifting too far forward. Keep the mast tilted back when traveling for maximum stability.

Do not accelerate or brake suddenly

Sudden movements affect forklift stability, so do not accelerate or brake suddenly.

Keep your movements slow, gradual, and deliberate. Maintain control of the forklift at all times, and adjust your speed as needed.

Also, don't suddenly change direction, which can shift the combined center of gravity rapidly and cause the vehicle to tip. Never turn on a forklift ramp or any kind of surface grade.

Do not exceed your lift's maximum load capacity

As discussed above, the load capacity has a huge impact on forklift stability, so never exceed the load capacity of your vehicle as described on the data plate or nameplate. Exceeding load capacity can very quickly cause the operator to either tip over or lose control of the steering. Make sure all lift truck operators on your job site are familiar with the vehicle's maximum lift capacity.

SELF-CHECK 3.3-1

1. What Is the Forklift Stability Triangle?
2. Tips to Improve Forklift Stability?

ANSWER KEY 3.3-1

- The forklift stability triangle is an invisible triangle formed by the pivot point on the rear axle and the two front wheels joined by the front axle.
- Keep the load low to the ground
- Do not accelerate or brake suddenly
- Do not exceed your lift's maximum load capacity