

METHOD STATEMENT SUBSTRUCTURE WORKS Academic PDF

Method Statement Substructure Works

A method statement for substructure works is a comprehensive document that outlines the systematic approach, procedures, safety measures, and quality standards to be followed during the construction of the substructure elements of a building or infrastructure project. This document ensures that all activities are carried out efficiently, safely, and in compliance with project specifications, relevant standards, and regulations. It serves as a vital communication tool between the project team, contractors, clients, and regulatory authorities, providing clarity on roles, responsibilities, and methodologies.

Introduction to Substructure Works

Definition and Importance of Substructure

The substructure forms the foundation of any structure, supporting the superstructure and transferring loads safely to the ground. It typically includes elements such as foundations, basements, piles, retaining walls, and slabs. The integrity and stability of the entire building depend heavily on the quality and correctness of the substructure works. Proper execution minimizes risks such as settlement, structural failure, and damage caused by environmental factors.

Objectives of the Method Statement

The primary objectives include:

- Ensuring the safety of personnel involved
- Guaranteeing quality and compliance with specifications
- Minimizing environmental impact
- Facilitating smooth workflow and coordination
- Managing risks effectively

Pre-Construction Activities

Site Investigation and Survey

Before commencing substructure works, thorough site investigations are essential. These include:

- Geotechnical investigations to determine soil properties
- Topographical surveys for accurate site layout
- Identification of existing underground utilities
- Assessment of groundwater conditions

The data collected guides design decisions, excavation depths, and construction techniques.

Design and Approval

The design process involves:

- Structural design of foundations and substructure elements
- Structural calculations and drawings
- Compliance with relevant standards (e.g., Eurocode, BS standards)
- Submission for approval to relevant authorities

Preparation of Construction Site

Prior to construction, site preparation includes:

- Clearing vegetation and debris
- Establishing access routes and haul roads
- Setting up site offices and facilities
- Installing temporary fencing and signage
- Arranging for utilities (water, electricity)

Procurement of Materials and Equipment

Procurement planning involves:

- Ordering reinforcement steel, formwork materials, concrete, and other consumables
- Arranging for plant and machinery, such as excavators, cranes, and piling rigs
- Ensuring materials meet project specifications and standards

Methodology for Substructure Works

Site Mobilization and Setup

- Mobilize resources, personnel, and equipment
- Establish safety measures, signage, and welfare facilities
- Mark out the excavation and foundation areas as per drawings

Excavation Works

- Conduct excavation in phases to prevent collapses
- Use appropriate shoring and bracing systems for unstable soils
- Remove excavated material and transport it for disposal or reuse
- Monitor excavation depths and slopes continuously

Foundation Construction

The type of foundation depends on soil conditions and design:

- Strip Foundations: Used for load-bearing walls
- Raft Foundations: Suitable for weak soils or high loads
- Pile Foundations: For deep bearing capacity requirements

The general steps include:

- Laying out foundations accurately using survey equipment
- Installing formwork to define the shape and size
- Placing reinforcement steel as per structural drawings
- Conducting reinforcement checks before concreting

Concrete Works

- Prepare and pour concrete in accordance with mix specifications
- Use vibration techniques to eliminate air pockets and ensure compaction
- Cure concrete appropriately to achieve desired strength
- Conduct compressive strength tests on concrete samples

Installation of Reinforcement

- Cut, bend, and place reinforcement steel according to detailed drawings
- Tie reinforcement securely to prevent displacement during concrete pouring
- Check for proper positioning and cover as per standards

Backfilling and Compaction

- Use suitable materials for backfill
- Compact in layers to prevent settlement
- Ensure proper compaction to achieve required density

Temporary Works and Shoring

- Design and install shoring systems where necessary
- Regularly inspect shoring for stability
- Remove temporary works only after confirming permanent stability

Health, Safety, and Environmental Management

Risk Assessment and Control Measures

- Identify potential hazards such as falls, equipment accidents, or soil collapse
- Implement control measures including PPE, safety barriers, and signage
- Conduct toolbox talks and safety briefings regularly

Safety Protocols

- Ensure all personnel are trained and competent
- Enforce use of PPE at all times
- Maintain clear access routes and emergency exits
- Establish emergency response procedures

Environmental Considerations

- Manage waste and excavated material responsibly
- Prevent contamination of water sources
- Minimize noise and dust pollution

- Protect local flora and fauna

Quality Control and Assurance

Inspection and Testing

- Conduct visual inspections at each stage
- Perform material testing (e.g., concrete cube tests, reinforcement checks)
- Monitor curing and compaction processes
- Record and document all test results

Non-Destructive Testing (NDT)

- Use NDT methods such as ultrasonic testing for reinforcement
- Conduct integrity tests on foundations and piles

Documentation and Records

- Maintain detailed logs of activities, inspections, and test results
- Issue quality certificates for completed works
- Prepare as-built drawings and reports

Completion and Handover

Final Inspections and Checks

- Ensure all works conform to drawings and specifications
- Rectify any defects or deficiencies
- Verify safety and stability of the substructure

Cleaning and Site Restoration

- Remove temporary works and debris
- Restore disturbed areas as per project requirements

Handover Procedures

- Prepare completion documents and reports
- Conduct handover meetings with clients
- Provide operation and maintenance manuals

Conclusion

Developing and implementing a detailed method statement for substructure works is critical for the success of any construction project. It ensures that all activities are carried out systematically, safely, and efficiently, reducing risks and ensuring quality. The method statement acts as a roadmap, guiding the workforce through each phase from site preparation to the final handover. Proper planning, adherence to safety and environmental standards, and continuous monitoring are essential components for achieving a durable, stable, and compliant substructure. By following a well-structured method statement, project teams can deliver high-quality foundations that underpin the overall integrity and longevity of the built structure.

Method Statement for Substructure Works: A Comprehensive Guide

Embarking on any construction project requires meticulous planning, especially when it comes to the substructure works. The method statement for substructure works serves as a critical document that outlines the detailed procedures, safety measures, and quality standards necessary to carry out these foundational activities efficiently and safely. This document not only ensures that all stakeholders are aligned but also helps mitigate risks, maintain compliance, and deliver the project within budget and schedule constraints.

Understanding Substructure Works

Before delving into the method statement, it's essential to understand what constitutes substructure works within a construction project.

What Are Substructure Works?

Substructure works refer to the activities involved in constructing the foundation and below-ground components that support the superstructure. These typically include:

- Excavation and site preparation
- Foundation construction (such as strip foundations, pad foundations, raft foundations)
- Basement construction (if applicable)
- Underpinning and ground improvement
- Construction of retaining walls
- Installation of subgrade drainage and utilities

The primary goal of substructure works is to transfer the load of the building safely into the ground, ensuring stability, durability, and compliance with design specifications.

Importance of a Method Statement in Substructure Works

A method statement for substructure works provides a step-by-step approach to executing these activities, highlighting safety protocols, quality control measures, and environmental considerations. It acts as a blueprint for the construction team, ensuring consistency and minimizing risks.

Benefits include:

- Clear communication of procedures
- Identification of potential hazards
- Compliance with statutory regulations
- Efficient resource allocation
- Documentation for inspections and audits

Components of a Method Statement for Substructure Works

A comprehensive method statement typically includes the following sections:

- Introduction and Scope

Defines the project details, location, and scope of substructure activities covered.

- References and Standards

Lists relevant codes, standards, and specifications (e.g., Eurocodes, BS standards).

- Responsibilities

Details roles and responsibilities of personnel involved.

- Materials and Equipment

Specifies types of materials, tools, machinery, and safety gear.

- Methodology

Provides detailed procedures for each activity from site clearance to backfilling.

- Safety and Environmental Measures

Outlines safety protocols, PPE requirements, and environmental controls.

- Quality Assurance

Describes inspection and testing procedures.

- Emergency Procedures

Details actions in case of accidents or unforeseen events.

- Documentation and Records

Lists forms, logs, and reports to be maintained.

Step-by-Step Guide to Developing a Method Statement for Substructure Works

Step 1: Project Planning and Site Assessment

- Site Investigation: Conduct geotechnical surveys to understand soil conditions, groundwater levels, and potential challenges.
- Design Review: Study drawings, specifications, and design calculations to understand structural requirements.
- Resource Planning: Identify required materials, machinery, and manpower.

Step 2: Risk Assessment and Safety Planning

- Identify hazards such as collapsing trenches, underground utilities, or hazardous soil.
- Develop risk mitigation strategies.
- Prepare safety plans, including emergency response procedures.

Step 3: Site Preparation

- Clear vegetation, debris, and existing structures.
- Establish site access points and signage.
- Install temporary fencing and barriers.
- Mark out excavation areas according to approved drawings.

Step 4: Excavation and Site Clearance

- Excavate to the required dimensions, ensuring stability.
- Use appropriate machinery like excavators, backhoes, and manual tools where necessary.
- Support excavations with shoring or trench boxes to prevent collapse.
- Remove excavated materials and dispose of or reuse as per environmental regulations.

Step 5: Foundation Construction

- Conduct subsoil testing to confirm soil bearing capacity.
- Place formwork and reinforcement as per design.
- Pour concrete for foundations, ensuring proper curing.
- Install any required drainage or utilities at this stage.

Step 6: Ground Improvement and Waterproofing (if applicable)

- Implement ground stabilization methods such as compaction, grouting, or piling.
- Apply waterproofing membranes to prevent water ingress.

Step 7: Backfilling and Compaction

- Backfill excavated areas with suitable material.
- Compact in layers to prevent settlement.
- Ensure proper compaction and moisture content.

Step 8: Inspection and Testing

- Conduct inspections at each stage (e.g., formwork, reinforcement placement).

- Perform testing such as concrete cube tests, soil compaction tests, and leak tests.

Step 9: Site Restoration

- Remove temporary supports and shoring.
- Re-grade and restore disturbed areas.
- Remove debris and prepare the site for subsequent construction phases.

Safety Considerations in Substructure Works

Safety is paramount in substructure activities due to inherent risks involved in excavation and heavy machinery operations.

Key Safety Measures:

- Shoring and Support: Always use appropriate shoring to prevent trench collapses.
- Equipment Safety: Regular inspection and maintenance of machinery.
- Worker Safety: Use PPE including helmets, gloves, safety boots, and high-visibility clothing.
- Monitoring: Continuous monitoring of ground stability and weather conditions.
- Utilities: Identify and manage underground utilities to prevent accidental strikes.
- Training: Ensure all personnel are trained in safe excavation practices.

Quality Control in Substructure Works

Maintaining high standards is crucial for the longevity and safety of the structure.

Quality Assurance Procedures:

- Use certified materials conforming to standards.
- Follow approved construction drawings and specifications.
- Conduct regular inspections and audits.
- Record test results and inspection reports.
- Address non-conformance promptly.

Environmental and Sustainability Considerations

Minimizing environmental impact is increasingly important in construction.

Strategies include:

- Proper disposal or reuse of excavated material.
- Preventing soil erosion and sediment runoff.
- Minimizing noise and dust pollution.
- Using eco-friendly materials where possible.

Conclusion

A method statement for substructure works is the backbone of a safe, efficient, and compliant foundation construction process. By systematically planning each phase?from site assessment and excavation to foundation pouring and backfilling?construction teams can ensure that the substructure is robust, durable, and constructed in accordance with best practices and regulatory standards. Emphasizing safety, quality, and environmental responsibility throughout the process not only safeguards personnel and the environment but also enhances the overall success of the construction project. Proper documentation and adherence to the method statement serve as vital tools for project management, quality assurance, and future maintenance.

Question What is a method statement for substructure works and why is it important? A method statement for substructure works is a documented plan detailing the procedures, safety measures, and sequence of activities involved in constructing the building's foundation and below-ground elements. It is important because it ensures work is carried out safely, efficiently, and in compliance with design and regulatory requirements, minimizing risks and ensuring quality. **What are the key components included in a method statement for substructure works?** Key components typically include project scope, site conditions, sequence of activities, materials and equipment to be used, safety procedures, risk assessments, environmental considerations, quality control measures, and emergency protocols. **How do you ensure health and safety are prioritized in substructure method statements?** Health and safety are prioritized by conducting thorough risk assessments, implementing safety measures such as shoring and bracing, providing proper training to workers, ensuring the use of PPE, and including emergency response plans within the method statement. **What are common challenges faced during substructure works and how does the method statement address them?** Common challenges include ground stability issues, water ingress, and unforeseen underground obstacles. The method statement addresses these by including contingency plans, detailed site investigations, appropriate excavation methods, and measures for controlling water and ground conditions. **How is the method statement for substructure works reviewed and approved?** The method statement is reviewed by project engineers, safety officers, and client representatives to ensure compliance with design specifications, safety standards, and contractual requirements. Once verified, it is formally approved before work commences. **What role does a risk assessment play in developing a method statement for substructure works?** A risk assessment identifies potential hazards associated with substructure activities, enabling the development of mitigation measures. It

ensures that all risks are considered and managed proactively, contributing to a safer and more efficient construction process.

Related keywords: substructure works, method statement, construction methodology, structural works, excavation procedures, foundation installation, safety procedures, site preparation, temporary supports, quality control

REGULA FALSI METHOD ADVANTAGES AND DISADVANTAGES

Regula Falsi Method Advantages and Disadvantages

The regula falsi method, also known as the false position method, is a numerical technique used to find approximate solutions to equations where the root is unknown. It is a bracketing method that combines the features of the bisection method and the secant method, aiming to improve convergence speed while maintaining reliability. Like any numerical approach, it offers a set of advantages that make it appealing for certain applications, but it also exhibits notable disadvantages that can limit its effectiveness in specific scenarios. Understanding these benefits and drawbacks is crucial for practitioners to decide when and how to employ the regula falsi method effectively.

Advantages of the Regula Falsi Method

1. Guaranteed Convergence Under Certain Conditions

One of the primary advantages of the regula falsi method is its guaranteed convergence, provided that the initial interval brackets a root and the function is continuous. Since the method always maintains an interval where the function changes sign, it ensures that the root lies within the bounds during each iteration. This reliability makes it a safe choice compared to open methods like the secant method, which may not always converge.

2. Simplicity of Implementation

The regula falsi method is straightforward to implement computationally. Its core involves calculating a linear approximation between two points and updating the interval based on the sign of the function at the approximated root. The simplicity of the algorithm makes it accessible even for beginners and easy to incorporate into larger computational routines or software.

3. Faster Convergence Than the Bisection Method

Compared to the bisection method, which halves the interval in each iteration, regula falsi often converges more quickly because it uses a secant-like approach to estimate the root. By adjusting the interval based on a linear approximation, it tends to reduce the number of iterations needed, especially when the initial interval is well-chosen and the function behaves approximately linearly near the root.

4. Fewer Function Evaluations Than Bisection

While both methods require function evaluations at each step, regula falsi often achieves a desired accuracy with fewer evaluations compared to bisection. This efficiency can be particularly valuable when function evaluations are computationally expensive or time-consuming.

5. Flexibility With Different Types of Functions

The method is applicable to a wide range of functions, including nonlinear and complex functions, as long as the initial interval brackets a root. Its reliance on linear approximation rather than derivatives makes it suitable even when derivative information is unavailable or difficult to compute.

Disadvantages of the Regula Falsi Method

1. Slow or Stagnant Convergence in Certain Cases

Despite its faster convergence relative to bisection, regula falsi can experience slow progress or stagnation, especially when the function exhibits certain behaviors. For example, if one endpoint of the interval is close to the root and the other is far, the method may repeatedly refine the approximation near one side without significantly improving the estimate overall. This phenomenon is known as "stagnation" and can lead to an impractical number of iterations.

2. Sensitivity to the Initial Interval

The effectiveness of the regula falsi method heavily depends on the choice of the initial bracketing interval. If the initial interval does not contain a root or is poorly chosen, the method may fail to converge or converge very slowly. The method requires a good initial approximation to be efficient and reliable.

3. Potential for Non-Progressive Iterations

In some cases, the method can get "stuck" or make negligible improvements over iterations. This occurs when the linear approximation becomes poor due to the nonlinear nature of the function, especially near inflection points or discontinuities. As a result, the method might oscillate or hover without substantial progress towards the root.

4. Not as Fast as Higher-Order Methods

Compared to methods like Newton-Raphson or secant methods, regula falsi generally converges more slowly because it is a bracketing method with linear convergence. For functions where derivative information is available and the function behaves well, higher-order methods can achieve quadratic or superlinear convergence, making regula falsi less efficient.

5. Computational Overhead in Some Variants

While the basic regula falsi method is simple, some advanced variants attempt to improve convergence by modifying how the new approximation is computed. These variants can introduce additional computational steps or complexity, which may negate some of the simplicity advantages of the original method.

Summary of Advantages and Disadvantages

Summary of Advantages

- Guaranteed convergence when the initial interval brackets a root
- Simple to implement and understand
- Generally faster than the bisection method
- Requires fewer function evaluations compared to bisection in many cases
- Applicable to a wide range of functions without needing derivatives

Summary of Disadvantages

- Can experience slow convergence or stagnation in certain functions
- Highly dependent on the choice of initial interval
- May get stuck or oscillate without significant progress
- Slower convergence compared to higher-order methods like Newton-Raphson
- Potential additional computational complexity in advanced variants

Conclusion

The regula falsi method remains a valuable tool in the numerical analyst's toolkit, especially when robustness and guaranteed convergence are prioritized over speed. Its advantages, such as simplicity, reliability, and efficiency, make it suitable for a variety of problems, particularly when derivative information is unavailable or the function is complex. However, its disadvantages, including potential stagnation and sensitivity to initial conditions, mean that practitioners should

exercise caution and consider alternative methods if rapid convergence is necessary or if the function exhibits challenging behavior. Understanding the balance between these advantages and disadvantages allows for more informed method selection and more effective problem-solving in numerical root-finding tasks.

Regula Falsi Method Advantages and Disadvantages

The regula falsi method, also known as the false position method, is a popular numerical technique used for finding roots of continuous functions. This iterative method provides an efficient way to approximate solutions to equations where analytical methods may be cumbersome or impossible. Its simplicity, combined with its ability to converge quickly under certain conditions, makes it a preferred choice among mathematicians, engineers, and scientists. However, like any numerical technique, the regula falsi method also has its limitations and drawbacks that are essential to understand for effective application.

Understanding the Regula Falsi Method

Before diving into its advantages and disadvantages, it's important to understand the basic concept of the regula falsi method.

Basic Concept

The regula falsi method is based on the idea of linear interpolation. Given a continuous function $f(x)$ and two points a and b such that $f(a)$ and $f(b)$ have opposite signs (indicating a root lies between them), the method approximates the root by drawing a straight line connecting the points $(a, f(a))$ and $(b, f(b))$. The intersection of this line with the x-axis provides a new approximation of the root, which then replaces either a or b based on the sign of the function at this intersection.

Step-by-Step Process

- Choose initial points a and b such that $f(a) \times f(b) < 0$
- Calculate the point c where the straight line connecting $(a, f(a))$ and $(b, f(b))$ intersects the x-axis:

$$c =$$

$$c = b - \frac{f(b)(a - b)}{f(a) - f(b)}$$

$$c =$$

- Evaluate $f(c)$. If $f(c)$ is sufficiently close to zero or within a desired tolerance, c is taken as the root.
- Otherwise, replace either a or b with c , depending on the sign of $f(c)$, and repeat the process.

Advantages of the Regula Falsi Method

Despite being a relatively simple numerical root-finding technique, the regula falsi method offers several notable advantages that make it appealing for various applications.

1. Simplicity and Ease of Implementation

- The regula falsi method relies on straightforward calculations involving linear interpolation, making it easy to implement even for beginners.
- No complex mathematical concepts or advanced programming skills are necessary, which allows for quick coding and testing.

2. Guaranteed Convergence under Certain Conditions

- When the initial interval $[a, b]$ contains a root and f is continuous, the method guarantees convergence to a root, provided the initial guesses are chosen appropriately.
- Unlike some methods, such as the secant method, the regula falsi method always converges if the initial bracketing is correct.

3. Faster than Bisection in Many Cases

- Since regula falsi uses linear interpolation, it often converges more rapidly than the bisection method, which simply bisects the interval regardless of the function's behavior.
- Especially when the function is well-behaved near the root, the method can achieve desired accuracy in fewer iterations.

4. No Need for Derivatives

- Unlike Newton-Raphson, the regula falsi method does not require the computation of derivatives, making it suitable for functions where derivatives are difficult or expensive to evaluate.

5. Suitable for Functions with Multiple Roots

- The method can be adapted to find multiple roots within a given interval by applying it iteratively over different subintervals.

Disadvantages of the Regula Falsi Method

While the regula falsi method has its merits, it also suffers from several significant drawbacks that can limit its effectiveness in certain scenarios.

1. Slow or Non-Uniform Convergence in Some Cases

- The method can experience "stalling" or very slow convergence when one endpoint remains fixed during iterations, especially if the function behaves poorly near the root.
- This occurs when the new approximation continually replaces only one endpoint, leading to a linear convergence rate similar to the bisection method rather than quadratic.

2. Dependence on Good Initial Brackets

- The success and efficiency of the method heavily depend on choosing initial points a and b such that $f(a)$ and $f(b)$ have opposite signs.
- Poor choices can lead to divergence, stagnation, or convergence to an incorrect root.

3. Potential for Stagnation

- In some cases, particularly with functions that are nearly flat or have multiple roots close to each other, the method may "stall," where the approximations do not improve significantly over iterations.
- This stagnation is problematic when quick convergence is desired.

4. Limited to Continuous Functions with Sign Changes

- The regula falsi method requires a continuous function with a known sign change over the interval. It is not suitable for functions that are discontinuous or do not satisfy this condition.
- Additional preliminary analysis is often necessary before applying the method.

5. Numerical Instability and Precision Issues

- When $f(a) \approx f(b)$, the denominator in the interpolation formula becomes very small,

leading to potential numerical instability.

- This can cause inaccuracies or divergence in the root approximation, especially when working with floating-point arithmetic.

Features and Variants

To address some of the shortcomings of the basic regula falsi method, several variants have been developed:

- Illinois Method: Adjusts the weight of the fixed endpoint to improve convergence.
- Pegasus Method: Uses a modified interpolation formula for faster convergence.
- Modified Regula Falsi: Incorporates dynamic updates to endpoints to prevent stagnation.

Each of these variants aims to retain the simplicity of the original method while improving convergence speed and stability.

Practical Applications and Suitability

The regula falsi method is particularly useful in scenarios where:

- The function is continuous and the initial bracket is known.
- Derivative information is unavailable or expensive to compute.
- Quick implementation and results are required.

However, for functions with complex behavior, multiple roots, or where high precision is crucial, other methods like Newton-Raphson or secant might be more appropriate.

Conclusion

The regula falsi method remains a fundamental numerical technique for root-finding due to its simplicity and guaranteed convergence under the right conditions. Its strengths lie in its straightforward implementation, no requirement for derivatives, and often faster convergence than bisection, especially for well-behaved functions. Nevertheless, it faces notable challenges, such as potential slow convergence, stagnation issues, and sensitivity to the initial interval selection.

For practitioners, understanding both the advantages and limitations of the regula falsi method is vital for its effective application. When combined with strategic initial guesses and possible variants, it can serve as a powerful tool in the numerical analyst's toolkit. However, for more complex functions or demanding precision, alternative methods or hybrid approaches may offer better

performance. Overall, the regula falsi method exemplifies the balance between simplicity and effectiveness in numerical root-finding techniques.

QuestionAnswer What are the main advantages of the regula falsi method? The regula falsi method is simple to implement, converges more reliably than some other methods for certain functions, and guarantees a root within the initial interval as long as the function is continuous and the initial guesses bracket the root. What are the disadvantages of using the regula falsi method? One major disadvantage is that it can converge slowly, especially if the function is flat near the root, and it may get stuck with one endpoint not moving if the function's values at the interval ends do not change significantly. How does the regula falsi method compare to the bisection method in terms of efficiency? While the regula falsi method often converges faster than the bisection method due to its use of linear interpolation, it can sometimes suffer from slow convergence or stagnation, unlike the guaranteed steady convergence of bisection. Can the regula falsi method be used for all types of functions? The method works best for continuous functions where the initial interval brackets a root; however, for functions with multiple roots or discontinuities, its effectiveness may be limited or require modifications. What are some improvements or variants of the regula falsi method to overcome its disadvantages? Variants like the Illinois and Anderson methods introduce modifications to the regula falsi technique to accelerate convergence and prevent stagnation, making the root-finding process more efficient. Is the regula falsi method suitable for automated or iterative root-finding algorithms? Yes, it is suitable for automated algorithms due to its straightforward implementation, but care must be taken to monitor convergence speed and avoid stagnation, especially for challenging functions.

Related keywords: regula falsi method, false position method, numerical analysis, root finding, bracketing methods, convergence rate, advantages, disadvantages, iterative methods, computational efficiency

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