

# Horizontal Directional Drilling Hdd Good Practices Guidelines

Horizontal Directional Drilling Hdd Good Practices Guidelines Horizontal Directional Drilling (HDD) Good Practices Guidelines Horizontal Directional Drilling (HDD) Good Practices Guidelines are essential for ensuring the success, safety, and environmental compliance of underground utility installation projects. HDD has revolutionized the way underground pipelines, cables, and conduits are installed, offering a minimally invasive alternative to traditional trenching. However, to maximize efficiency and minimize risks, adherence to established best practices is paramount. This comprehensive guide provides industry-standard procedures, safety protocols, and technical recommendations to help contractors, engineers, and project managers execute HDD projects effectively and sustainably. Understanding Horizontal Directional Drilling Horizontal Directional Drilling is a trenchless method that involves drilling a pilot bore along a predetermined path, then enlarging it to accommodate the utility line. This technique is ideal for crossing obstacles such as roads, rivers, or environmentally sensitive areas where traditional excavation is impractical or undesirable. HDD offers advantages like reduced surface disruption, minimized environmental impact, and faster project completion times. Key Components of HDD Operations - Drill Rig: The primary equipment that powers the drilling operation. - Guidance System: Ensures the bore follows the planned path using electronic or magnetic guidance. - Drill Pipe and Stem: Connects the drill bit to the surface equipment. - Mud System: Provides lubrication, cools the drill bit, and transports cuttings to the surface. - Reamer: Enlarges the borehole to the required diameter. - Pullback Equipment: Pulls the conduit or pipe through the borehole. Essential Good Practices for HDD Projects Implementing best practices across all phases of HDD projects is vital. These practices enhance safety, improve project outcomes, and reduce environmental risks. Pre-Construction Planning and Design Effective planning lays the foundation for a successful HDD operation. - Site Assessment: - Conduct detailed subsurface investigations, including geotechnical surveys, to understand soil conditions. - Identify potential obstacles such as rock formations, existing utilities, or groundwater issues. - Obtain all necessary permits and environmental clearances. - Design Accuracy: - Develop precise bore path profiles, including entry and exit

angles. - Use CAD and GIS tools for accurate modeling. - Plan for contingency options in case of unforeseen conditions. - Material and Equipment Selection: - Choose appropriate drill bits and reamers based on soil and rock types. - Select suitable drilling fluids to match soil conditions. - Ensure equipment is well-maintained and calibrated. - Stakeholder Communication: - Inform local authorities, utilities, and communities about project scope and schedule. - Establish clear communication channels for real-time updates. Site Preparation and Setup Proper site setup reduces risks and improves operational efficiency. - Clearance and Safety Zones: - Establish safety zones around the drilling site. - Remove or protect existing utilities and underground structures. - Equipment Setup: - Position drilling rig on stable ground. - Ensure proper anchoring and leveling. - Verify the functionality of guidance systems and monitoring devices. - Environmental Protections: - Install silt fences, spill containment, and other erosion controls. - Prepare contingency plans for fluid spills or leaks. Drilling Operations Best Practices Executing the drilling process with precision is critical. - Guidance and Monitoring: - Use electronic guidance systems for accurate bore path control. - Continuously monitor bore trajectory, pressure, and mud flow. - Adjust drilling parameters in real-time based on feedback. - Mud Management: - Maintain appropriate mud properties (viscosity, density). - Monitor mud volume and flow rate. - Implement filtration and recycling systems to reduce waste. - Controlled Drilling: - Maintain steady drilling speeds to prevent borehole collapse. - Use appropriate reaming techniques to minimize soil disturbance. - Avoid sudden changes in direction or depth. - Obstacle and Problem Management: - Recognize signs of drill pipe sticking or deviation. - Employ corrective measures promptly, such as adjusting the drill path or reaming. Pullback and Installation Proper handling during conduit installation ensures integrity and safety. - Conduit Preparation: - Inspect conduit for damage. - Use lubrication compatible with the conduit material. - Pullback Procedure: - Attach the conduit securely to the pullback equipment. - Maintain controlled pulling speeds. - Monitor tension and fluid pressures continuously. - Post-Installation Inspection: - Conduct pressure testing. - Verify the alignment and depth. - Document the installation process comprehensively. 3 Post-Construction and Quality Assurance Final steps ensure project longevity and compliance. - Site Restoration: - Refill bore entry and exit points. - Restore surface conditions, including pavements or landscaping. - Documentation and Reporting: - Compile detailed records of the bore path, equipment used, and encountered conditions. - Submit reports to relevant authorities and stakeholders. - Maintenance and Monitoring: - Schedule inspections for potential issues such as leaks or ground movement. - Implement preventative maintenance for installed utilities. Safety Protocols and Risk Management Safety is a cornerstone of HDD good practices. Adhering to safety

protocols minimizes accidents and environmental hazards. - Personal Protective Equipment (PPE): - Require helmets, gloves, eye protection, and high-visibility clothing. - Training and Certification: - Ensure all personnel are trained in HDD operation, safety procedures, and emergency response. - Equipment Safety Checks: - Perform routine inspections before each shift. - Maintain proper guarding and emergency shut-off systems. - Environmental Safety: - Prevent drilling fluids from contaminating soil and water sources. - Have spill response kits on-site and trained personnel ready. - Emergency Preparedness: - Develop and communicate emergency response plans. - Conduct regular drills. Environmental Considerations and Sustainable Practices HDD projects should prioritize environmental sustainability. - Minimize Surface Disruption: - Use precise guidance to avoid unnecessary excavation. - Schedule work during optimal times to reduce impact. - Proper Waste Management: - Recycle drilling fluids and cuttings where feasible. - Dispose of waste materials according to environmental regulations. - Water and Soil Protection: - Use barriers to prevent runoff. - Monitor groundwater conditions during drilling. - Community Engagement: - Inform communities about project benefits and potential disruptions. - Address concerns proactively. Common Challenges and How to Overcome Them Understanding potential hurdles helps in proactive management. - Bore Path Deviation: - Use advanced guidance systems. - Reassess and adjust the bore path as needed. - Drill Pipe Sticking: - Maintain proper mud properties. - Use lubricants and proper reaming techniques. - Ground Collapse or Caving: - Control drilling parameters. - Use appropriate borehole reinforcement if necessary. - Environmental Incidents: - Implement strict spill prevention protocols. - Have contingency plans for containment and cleanup. 4 Conclusion Adhering to horizontal directional drilling (HDD) good practices guidelines is crucial for the successful, safe, and environmentally responsible completion of underground installation projects. From meticulous pre-construction planning to post-installation assessments, each phase benefits from standardized procedures, safety protocols, and technical expertise. By fostering a culture of continuous improvement, training, and environmental stewardship, HDD practitioners can deliver durable infrastructure solutions that meet modern standards and community expectations. Implementing these guidelines not only minimizes risks but also enhances project efficiency and sustainability, positioning HDD as a preferred method in the utility and infrastructure sectors. QuestionAnswer What are the key safety considerations in horizontal directional drilling (HDD) projects? Key safety considerations include proper site assessment, use of personal protective equipment (PPE), ensuring accurate bore planning, monitoring for unexpected ground conditions, maintaining equipment properly, and adhering to safety protocols to prevent accidents and environmental hazards. How

can proper soil and geology assessment improve HDD project outcomes? Thorough soil and geology assessments help identify potential challenges such as unstable ground or obstructions, enabling accurate bore planning, reducing risks of drill failure, minimizing environmental impacts, and ensuring project efficiency and safety. What are the best practices for maintaining HDD equipment during a project? Best practices include regular inspection and maintenance, ensuring proper lubrication, checking hydraulic systems, calibrating steering tools, and following manufacturer guidelines to prevent equipment failure and extend operational lifespan. How important is pilot hole alignment and steering in HDD operations? Accurate pilot hole alignment and steering are crucial for reaching target points precisely, avoiding obstacles, reducing rework, and ensuring the structural integrity of the installed pipeline or conduit. What environmental considerations should be addressed during HDD projects? Environmental considerations include preventing soil erosion, avoiding groundwater contamination, managing drilling fluids responsibly, minimizing surface disturbance, and obtaining necessary permits to ensure compliance with environmental regulations. How can HDD projects minimize ground settlement and surface disruptions? By maintaining proper drilling parameters, monitoring ground conditions continuously, controlling drilling fluid pressure, and using appropriate bore techniques, projects can reduce ground settlement and surface disruptions. 5 What role does project planning and site assessment play in HDD good practices? Effective project planning and thorough site assessment help identify potential risks, optimize bore path design, allocate resources efficiently, and establish safety and environmental protocols, leading to smoother project execution. What are common troubleshooting tips when encountering drilling difficulties? Troubleshooting tips include checking for equipment blockages, adjusting drilling fluid properties, verifying bore path accuracy, pausing to evaluate ground conditions, and consulting experienced operators to adapt techniques as needed. How can technology innovations improve HDD good practices and project success? Technologies such as real-time monitoring systems, advanced steering tools, GIS mapping, and data analytics enhance precision, safety, and efficiency, enabling proactive decision-making and minimizing project risks. Horizontal Directional Drilling (HDD) Good Practices Guidelines

Horizontal Directional Drilling (HDD) has revolutionized underground utility installation, pipeline laying, and infrastructure development by enabling trenchless crossings beneath obstacles such as rivers, roads, and environmentally sensitive areas. As a complex and technically demanding process, HDD requires rigorous adherence to best practices to ensure safety, efficiency, environmental protection, and project success. This article provides a comprehensive, informative, and analytical overview of HDD

good practices guidelines, offering insights into key aspects ranging from planning and design to execution and post-installation. --- Introduction to Horizontal Directional Drilling (HDD) Horizontal Directional Drilling is a trenchless method that involves drilling a pilot bore along a predetermined path, then enlarging the bore to accommodate the installation of pipelines, cables, or conduits. The technique minimizes surface disruption, reduces environmental impact, and allows access to challenging terrains. However, HDD's success hinges on meticulous planning, precise execution, and adherence to established guidelines. --- Pre-Construction Planning and Design Effective HDD projects begin long before the drilling equipment is mobilized. Pre- construction planning and design lay the foundation for safe, efficient, and environmentally responsible operations.

1. Site Investigation and Subsurface Characterization A comprehensive site investigation is vital to understand subsurface conditions, including Horizontal Directional Drilling Hdd Good Practices Guidelines 6 soil types, groundwater levels, existing underground utilities, and environmental constraints. Techniques include:

- Geotechnical borings and sampling
- Geophysical surveys
- Utility locates and mapping
- Environmental assessments

Understanding these parameters informs equipment selection, bore path design, and risk mitigation strategies.

2. Alignments and Route Selection Optimal route selection involves balancing technical feasibility, environmental impact, and cost considerations. Factors include:

- Avoidance of environmentally sensitive areas
- Minimizing crossing depths and lengths
- Compatibility with existing infrastructure
- Accessibility for equipment and personnel

Utilizing advanced modeling tools and 3D GIS mapping enhances accuracy in route planning.

3. Drill Path Design and Boring Parameters Designing the bore path involves defining the entry and exit points, bore depth, and curvature constraints. Considerations include:

- Minimum bend radii to prevent drill string stress
- Vertical and horizontal alignment optimization
- Ground conditions influencing bore diameter and fluid requirements
- Establishing contingency plans for unforeseen subsurface conditions

Proper design reduces the risk of hole deviation, blockages, and other issues.

4. Regulatory Compliance and Permitting Securing necessary permits and ensuring compliance with local, regional, and national regulations are essential. This includes environmental permits, utility crossing approvals, and safety standards. --- Equipment Selection and Preparation Choosing the right equipment and preparing it adequately significantly impacts project outcomes.

1. Drilling Rig and Accessories Selection criteria should include:

- Rig capacity and size appropriate for bore diameter and length
- Power and torque capabilities
- Compatibility with drill pipe and reamer sizes
- Mud mixing and circulation systems

Accessories like drill pipes, reamers, mud motors, and tracking systems should be selected based on project specifications.

2. Fluid Management Systems

Fluid (usually bentonite or polymer-based mud) is critical for bore stability, cuttings Horizontal Directional Drilling Hdd Good Practices Guidelines 7 transport, and lubrication. Proper systems to mix, circulate, and monitor fluid properties must be established to prevent issues like backreamer jamming or hole collapse.

3. Utility Locating and Tracking Systems Accurate real-time tracking ensures the drill follows the designed path. Technologies such as magnetic, electromagnetic, or acoustic systems should be calibrated and tested before operations.

4. Site Preparation and Access Preparing the site involves:

- Clearing vegetation and debris
- Establishing level and stable work surfaces
- Creating access roads for equipment transport
- Ensuring safety zones around drilling areas

Proper site prep minimizes delays and safety hazards.

--- Execution Best Practices Executing HDD with good practices ensures project efficiency, safety, and environmental compliance.

1. Pilot Hole Drilling The pilot bore is the foundation for the entire project. Best practices include:

- Maintaining steady drilling speeds to prevent deviations
- Monitoring drilling parameters continuously (e.g., torque, pullback, pressure)
- Adjusting drilling fluid properties to optimize hole stability
- Using real-time guidance systems for accurate trajectory control
- Managing cuttings and debris efficiently to prevent blockages

Regularly inspecting drill rods and components reduces mechanical failures.

2. Hole Navigation and Deviation Control Maintaining the planned bore path requires:

- Close monitoring of position data from tracking systems
- Adjusting drill bit orientation as needed
- Using pre-survey data to compare actual bore trajectory
- Employing correction techniques like steering adjustments

Deviation control minimizes the risk of hitting obstacles or exceeding crossing tolerances.

3. Hole Enlargement and Reaming Once the pilot hole is complete, enlarging it to the required diameter involves:

- Selecting appropriate reamers based on bore size and ground conditions
- Reaming in stages if necessary
- Ensuring fluid pressure and flow rates are adequate
- Monitoring for signs of hole instability or reamer jamming

Proper reaming ensures smooth installation of the Horizontal Directional Drilling Hdd Good Practices Guidelines 8 pipeline or conduit.

4. Pullback Operations Pulling the pipe or conduit through the bore demands:

- Using appropriate pullback force to prevent material stress or damage
- Maintaining continuous, steady draw to avoid bore collapse
- Employing lubricants or specialized coatings on the conduit
- Monitoring tension and fluid pressures throughout

Careful pullback reduces the risk of pipe deformation and surface disturbances.

5. Environmental and Safety Management Throughout execution, adherence to environmental and safety protocols is paramount:

- Controlling drilling fluids to prevent surface or groundwater contamination
- Managing waste cuttings responsibly
- Implementing safety zones and signage
- Conducting regular safety briefings and training
- Having emergency response plans in place

place Proactive safety and environmental management safeguard personnel and ecosystems. --- Post-Installation and Site Restoration Completing HDD projects involves verifying installation integrity and restoring sites. 1. Quality Assurance and Verification Post-installation checks include: - Conducting pressure tests and inspections for pipeline integrity - Verifying bore alignment and depth via surveys - Checking for leaks or damage - Documenting the installation process Non-destructive testing methods and as-built surveys provide confidence in project quality. 2. Site Restoration and Reinstatement Restoring disturbed areas involves: - Replacing topsoil and revegetation - Repairing surface disruptions - Removing equipment and debris - Implementing erosion control measures Restoration minimizes environmental impact and complies with permits. --- Challenges and Risk Management in HDD Despite best practices, HDD projects encounter challenges requiring proactive risk management. - Unexpected Subsurface Conditions: Unforeseen rock formations or voids can cause drill string jamming or deviation. - Bore Hole Collapse: Inadequate planning or poor fluid management can lead to instability. - Equipment Failures: Mechanical issues necessitate contingency plans and spare parts. - Environmental Risks: Fluid spills or habitat disturbance require mitigation strategies. - Utility Strike: Accurate locating and monitoring prevent accidental utility hits. Implementing risk assessments, contingency Horizontal Directional Drilling Hdd Good Practices Guidelines 9 planning, and continuous monitoring are crucial for mitigating these issues. --- Conclusion: Embracing Good Practices for Successful HDD Projects Horizontal Directional Drilling is a transformative technology that, when executed with discipline and adherence to good practices guidelines, yields safe, cost-effective, and environmentally responsible results. The key to success lies in meticulous planning, precise execution, vigilant monitoring, and thorough post-project evaluation. As technology advances and environmental considerations grow, continuously updating and refining HDD best practices becomes essential, ensuring this trenchless method remains a reliable solution for modern infrastructure challenges. By embracing these comprehensive guidelines, industry professionals can optimize project outcomes, minimize risks, and uphold the highest standards of safety and environmental stewardship in HDD operations. horizontal directional drilling, HDD, drilling best practices, HDD guidelines, trenchless technology, bore planning, pipe installation, ground conditions, safety protocols, project management

Horizontal Directional Drilling (HDD)Horizontal Directional DrillingPipeline Design for Installation by Horizontal Directional DrillingHDD Practice HandbookPipeline Design for Installation by Horizontal Directional DrillingTrenchless Installation of Conduits

Beneath Roadways Pipeline Design for Installation by Horizontal Directional Drilling Evaluation of Horizontal Directional Drilling (HDD) Horizontal Directional Drilling (HDD) Good Practices Guidelines Development of a Model for Productivity of Horizontal Directional Drilling (HDD) Drilling and Foundation Machinery. Horizontal Directional Drilling (HDD) Machines. Commercial Specifications Implementation of Safety and Health on Construction Sites Development of a Standard Specification for Horizontal Directional Drilling Fluidic Drag in Horizontal Directional Drilling and Its Application in Specific Energy MRTS140 Horizontal Directional Drilling (HDD) BS ISO 21467. Drilling and Foundation Machinery. Horizontal Directional Drilling (HDD) Machines. Commercial Specifications Hackenberry LNG Project Horizontal Directional Drilling Underground Infrastructure Research Productivity Analysis of Horizontal Directional Drilling David Willoughby David Bennett Eric R. Skonberg Hans-Joachim Bayer American Society of Civil Engineers. Horizontal Directional Drilling Design Guideline Task Committee Tom Iseley Eric R. Skonberg Youssef M. A. Hashash David Bennett Mohmd Sarireh British Standards Institution Amarjit Singh Alan Atalah Ashkan Faghah British Standards Institution HDD Consortium M. Knight Muhammad Adel Ahmed Mahmoud

Horizontal Directional Drilling (HDD) Horizontal Directional Drilling Pipeline Design for Installation by Horizontal Directional Drilling HDD Practice Handbook Pipeline Design for Installation by Horizontal Directional Drilling Trenchless Installation of Conduits Beneath Roadways Pipeline Design for Installation by Horizontal Directional Drilling Evaluation of Horizontal Directional Drilling (HDD) Horizontal Directional Drilling (HDD) Good Practices Guidelines Development of a Model for Productivity of Horizontal Directional Drilling (HDD) Drilling and Foundation Machinery. Horizontal Directional Drilling (HDD) Machines. Commercial Specifications Implementation of Safety and Health on Construction Sites Development of a Standard Specification for Horizontal Directional Drilling Fluidic Drag in Horizontal Directional Drilling and Its Application in Specific Energy MRTS140 Horizontal Directional Drilling (HDD) BS ISO 21467. Drilling and Foundation Machinery. Horizontal Directional Drilling (HDD) Machines. Commercial Specifications Hackenberry LNG Project Horizontal Directional Drilling Underground Infrastructure Research Productivity Analysis of Horizontal Directional Drilling *David Willoughby David Bennett Eric R. Skonberg Hans-Joachim Bayer American Society of Civil Engineers. Horizontal Directional Drilling Design Guideline Task Committee Tom Iseley Eric R. Skonberg Youssef M. A. Hashash David Bennett Mohmd Sarireh British Standards Institution Amarjit Singh Alan Atalah Ashkan Faghah British Standards Institution HDD Consortium M. Knight Muhammad Adel Ahmed Mahmoud*

this is a complete sourcebook of information on horizontal directional drilling the installation of pipelines and utilities beneath obstacles such as water and roadways hdd is a fast growing technology in the trenchless industry provides technical information on the design permitting construction bid documents specifications and construction of hdd applications numerous hdd calculations with examples

mop 108 third edition addresses the design of major pipeline or duct segments to be installed by horizontal directional drilling hdd

this handbook is written for planning engineers construction engineers and technicians for pipeline and network engineers and technicians for engineering companies for construction and pipeline companies for network and pipeline owners for installation companies of mains cables fibers ducts sewers and complete networks for drillers of all branches for drilling fluid specialists for environmental and water management applications for foundations specialists for all people engaged in the underground infrastructure for all which like to combine economical and ecological advantages by going trenchless and by using newest technological possibilities for underground construction

mop 108 addresses the design of major pipeline or duct segments to be installed by horizontal directional drilling hdd

this synthesis will be of interest to geologists geotechnical construction and maintenance engineers other state department of transportation dot personnel involved with the planning design and permit issuance for conduits beneath roadways local transportation agencies utility contractors and consultants and trenchless construction equipment manufacturers it describes the current state of the practice for the use of trenchless technology for installing conduits beneath roadways trenchless construction is a process of installing rehabilitating or replacing underground utility systems without open cut excavation the synthesis is focused on trenchless technology for new installations this report of the transportation research board describes the trenchless installation technologies methods materials and equipment currently employed by state dots and other agencies to install conduits beneath roadways the synthesis presents data obtained from a review of the literature and a survey of transportation agencies for each technology identified information is provided to describe the range of applications basis for technique selection site specific design

factors to be considered relative costs common environmental issues and example specifications in addition information on emerging technologies and research needs is presented

horizontal directional drilling hdd is a growing method for installation of pipes in urban areas and where trenching is impossible or undesirable such as in crossing rivers lakes railways and special areas such as airports this technique utilizes downhole cutting heads to create a pilot borehole before it is enlarged with back reamers to allow pulling back of a product pipe the utilization of hdd for the installation of underground infrastructure i e water wastewater oil and gas pipes telecommunication and power conduits has shown a rapid growth compared to other trenchless technologies hdd can install a range of pipe diameters from 2 to 60 inches utilizing different pipe materials including steel high density polyethylene hdpe polyvinyl chloride pvc and ductile iron pipe dip with minimum surface and daily life disruptions estimation of hdd productivity project duration and quantity of materials required is a difficult task due to variable productivity conditions such soil project contractor and machine conditions involved in operation the objectives of this research are to define the significant subconditions that affect hdd productivity by utilizing the analysis of variance anova model to develop hdd productivity prediction model and to develop hdd user interface as a planning tool for operation initially the main productivity conditions and subconditions were identified through literature review and consulting the hdd experts and professionals a hdd questionnaire was designed reviewed and sent to hdd experts contractors design engineers and consultants to collect data addressing hdd operation conditions required for testing significance of subconditions and modeling operation productivity hdd subconditions that show significance by anova model analysis will be used to model hdd productivity in clayey and rocky conditions this model is applicable in predicting hdd productivity to estimate duration of hdd project in addition to other project parameters such as quantities of materials required and cost of labor applications on hdd productivity model will be useful for consultants and contractors for planning scheduling and bidding of hdd projects during preconstruction stage as well as during installation and construction

the text offers 123 articles on recent research and practice in construction safety from 19 developed countries topics covered include safety management and planning education and training innovative safety technology site safety and progra

horizontal directional drilling hdd has become one of the fastest growing trenchless technology construction methods for the installation of underground pipelines and conduits according to the board of directors of the ohio horizontal directional drilling association ohdda there are many hdd specifications employed in ohio and these specifications vary significantly in their content and requirements consequently inferior products may have been installed unnecessary risks may have been taken and the competition among contractors may have been compromised therefore a hdd specification that provides for high quality installations allocates risks appropriately and ensures correct design and installation of product pipes without damaging the roadway is needed the proposed draft was based on comparison of more than 12 existing hdd specifications with the hdd good practice guidelines and the collective input from professional partners representing the interest of the various entities involved in a typical hdd project the research team along with the professional partners proposed draft specification for pressurized applications with pipe diameters in the range of 4 inches 10 cm to 24 inches 60 cm installations outside this range of pipe sizes and gravity installations are beyond the scope of the specification the implementation plan for the draft specification includes odot review to ensure it does not conflict with other odot specifications odot evaluation of the proposed specification through use on an actual project feedback from the larger interest groups across the state of ohio and update as needed

horizontal directional drilling hdd is one of the most rapidly growing technologies for utility installation under surface obstacles the rapid growth in application of hdd has not accompanied the same level of development in engineering design procedures and efficient drilling techniques rational engineering design and maximized drill rate are of a great value particularly in longer hdd crossings where the project budgets are in the order of millions of dollars and daily delays cost tens of thousands of dollars baumert and allouche 2002 to improve predictions of pulling load by current design practices exact equations for annular flow are derived in this thesis to accurately compute the fluidic drag during hdd operations comparisons of the exact solution with the predictions by design procedures such as prci and astm 1962 reveal that prci overestimates the fluidic drag while astm f1962 results in a better estimation to maximize the rate of penetration and identify underground drilling risks the concept of specific energy se of drilling is proposed here to be used in hdd se has been implemented successfully in oil and gas industry as a useful efficiency indicator of drilling operations to calculate the real se used by the bit to excavate the material downhole drilling data should be measured during

the process utilization of sophisticated downhole measuring tools is not economical in hdd therefore a mechanical model is developed to calculate downhole loads and torques using the result of the previous analysis on the fluidic drag finally an example application of se in hdd is illustrated in a case study and the se analysis for surface and downhole conditions are presented

a collection of papers from the international symposium underground infrastructure research municipal industrial and environmental applications 2001 it explores materials for buried pipelines pipeline construction techniques and condition assessment methods and more

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