

EXCAVATION WORK SAFETY PROCEDURE

AGREEMENT NO. : 09-5578-E-4

PROJECT NAME : Ruwais Refinery Expansion Project
EPC-4: Tankage & Associated
Interconnecting Piping

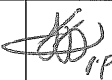



COMPANY : Abu Dhabi Oil Refining Company (TAKREER)

PMC : Mott MacDonald Ltd.

CONTRACTOR : Daewoo Engineering & Construction Co., Ltd.

TAKREER	RUWAI'S REFINERY EXPANSION PROJECT	DAEWOO E&C	
	EPC-4 TANKAGE AND ASSOCIATED INTERCONNECTING PIPING		
	AGREEMENT No. 09-5578-E-4		
PROJECT No. 5578	Doc. No. 5578-E4-HSE-HU-00010	Rev. 0	Page 2 / 15

This page is a record of all revisions of this document. All previous issues are hereby superseded and are to be destroyed.

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SIGNED (Initials)							

NOTES:

- (a) Revisions are denoted by a vertical line placed in the right-hand margin against the revised text.
- (b) PREP = Prepared by, CHKD = Checked by, REVD = Reviewed by, APP'D = Approved by.
- (c) In case of conflict between any requirements stipulated in this document with the contractual requirements, the contractual requirements shall prevail.

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REVISION INDEX DETAILS

Rev	Location of Change	Brief Description of Change
0	Table of Contents	Added point 3.4 & 3.5, and changed page numbers
0	3.4	New section on responsibilities of Machinery Operator
0	3.5	New section on responsibilities of Banksman
0	4.2	Added that all excavations shall be hard barricaded
0	4.3	Spoils to be disposed in line with Environmental Plan

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1. INTRODUCTION

The procedure has been developed and will be implemented due to the large volume of excavation work that will be carried out on the Ruwais Refinery Expansion project. It is estimated that almost one (1) million cubic meters of soil will be excavated from the site.

1.1 Purpose

The purpose of this procedure is to ensure the safe execution of all excavations during the construction and commissioning phases of related construction activities involved in the Ruwais Refinery Expansion Project.

1.2 Scope

The scope of this procedure covers all excavations to be carried out in all on the EPC 4 package area within Ruwais.

1.3 Objective

The objective of this procedure is;

- To clearly define the safe work requirements for excavation works
- Define specific roles and responsibilities related to this procedure
- Outline the control measures that will be used to mitigate the risks involved with excavation works

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2. DEFINITION S

Benching	A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal steps, with a vertical rise between steps.
Company	Abu Dhabi Oil Refining Company (TAKREER)
Contractor	Daewoo Engineering and Construction Company Ltd.
Excavation	An excavation is defined as: <ul style="list-style-type: none"> - Any removal of soil, whether by hand or mechanical means. - Removal of more than 30 cm of topsoil. - Driving of any peg or stake below grade.
PMC	Mott MacDonald
Protective System	Methods used to protect employees from cave-ins, from materials that could fall or roll into the excavation onto the workers or from collapse of adjacent structures. Protective systems include supports, sloping and benching, shields and other means to protect workers.
Shoring	Hydraulic, timber or mechanical systems that support the sides of an excavation, designed to prevent cave-ins.
Sloping	A method of excavating in which the sides of an excavation are laid back to a safe angle to prevent cave-ins. (The safe angle required varies with different types of soil, exposure to the elements and superimposed loads. There is no single angle of repose. Soil classification must be identified to select safe sloping and benching methods.)
Spoils	Excavated soil.
Trench box	A structure that is able to withstand the forces imposed on it by cave-ins and in the process, protects employees inside the structure.

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3. ROLES & RESPONSIBILITIES

3.1 Project Manager

The Project Manager has the over responsibility to ensure that all excavation works carried out on the project shall meet the criteria mentioned herein this procedure.

3.2 HSE Manager

The HSE Manager will have the following responsibilities;

- Shall monitor compliance to permit to work (PTW) requirements for excavations
- Will provide training for persons involved in excavation activities
- Ensure that inspections of excavations is carried out on a regular basis

3.3 Civil Manager

The Civil Manager will have the following responsibilities;

- Ensure that the correct equipment is provided to execute the work
- Arrange the sequence of excavations in coordination with other departments
- Manage the removal, temporary storage and backfilling of spoils
- Assign competent persons to carry out excavation works

3.3 Civil Supervisors

The Civil supervisors will have to the following responsibilities;

- Complete the permit to work forms and attached all required documentation
- Ensure that his staff carry out Excavation Safety Training
- He will ensure that all control measures are implemented before, during and after completion of excavations
- Ensure that only inspected tools and equipment is used to carry out the work.

3.4 Machinery Operators

The machinery operators will have the following responsibilities;

- Ensure that they attend the relevant HSE training such as excavation safety & fire prevention
- Will have to undergo third party certification for operation of the equipment, and will need a valid UAE license

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- Should only work when a banksman is in place to support activities, and will only move equipment on site when a banksman is available to guide such equipment
- Ensure that all control measures are taken before the start of work such as barricades, signage, PTW etc.
- Inspect equipment before the start of each activity
- Take care whilst using equipment as not to cause damage to plant or equipment
- Ensure that windows are unobstructed and that there is a clear view available

3.5 Banksman

The banksman will have the following responsibilities;

- Will have to attend the relevant HSE training such as banksman training, fire prevention, excavation safety etc.
- Ensure that high visibility vest is always worn and that flags are available
- Will guide heavy machinery on site, and monitor activities
- Ensure that activity is immediately suspended if hazards are detected
- Support machinery operators in their responsibilities

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4. GENERAL REQUIREMENTS

Excavations during site establishment shall be carried out under a blanket excavation permits, until electrical cabling or underground services have been installed. At this point a specific job excavation permit will be issued for excavations.

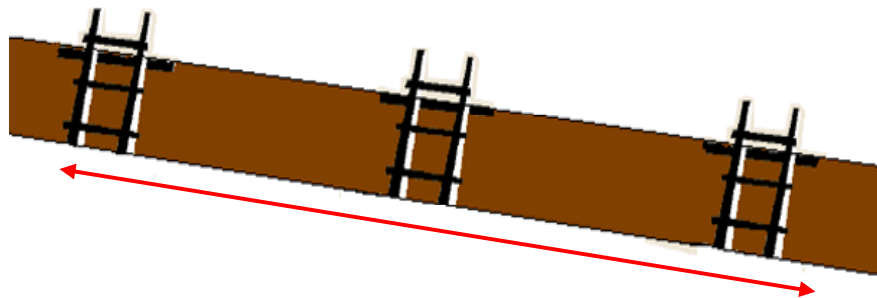
Job specific excavation permits will be raised by the permit receiver and approved by the permit issuer. The PTW and relevant excavation certificate/ permit will include drawings detailing the area and depth of intended excavation, the excavation design, equipment to be used and drawings of any underground facilities. Once the PTW is approved it will be kept at the work site in the possession of the job supervisor and a copy of the permit will be kept in the PTW office.

The job supervisor shall ensure that the operator of the excavator (or any other relevant equipment) is fully conversant with and will abide by the requirements of the permit at all times. HSE personnel will continuously inspect excavations and suspend operations where breaches of the permit conditions are identified.

Due to the fact that the site is a green field construction area, excavations deeper than 1.2m will not be considered a confined space, unless the excavation is within 30m of the live piping corridor, or if so required by the scope of the work (i.e. using bonding chemicals inside the trench). The PTW coordinator will carry out an evaluation on a case to case basis and may refer to the HSE- or Construction Manager when in doubt. This is due to the fact that most toxic gases are heavier than air and settles down at the lowest part of the earth. In such cases a PTW with confined space entry certificate/ permit shall be required before entering and performing any kind of task inside such excavations.

4.1 Access/ Egress

Access to and egresses from all excavations undertaken during the construction of the project are to be constructed in a manner and from material that will provide safe and unhindered access to and egress from the excavation. Any excavation deeper than 1.2 meters, safe access/egress shall be provided by ladders, stairs or ramps at intervals not to exceed 15 meters of travel.



NO MORE THAN 15 METERS OF LATERAL TRAVEL

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4.2 Barricading/ Edge Protection

All excavations deeper than 1.2 meters shall be shored, benched or shored slopes depending on the type of soil being excavated. The excavation shall have a barrier constructed one meter from the edge of the excavation so as to indicate the presence of a hazard. In areas of heavy vehicular or pedestrian traffic, rigid guardrails fitted with high visibility tape, which shall be not less than 900mm in height from the ground, shall be erected around the excavation. "DANGER - EXCAVATION" signs must be placed to give warning. As far as reasonably practical excavations will have hard barricades installed.

Excavations deeper than 300mm but less than 1.2 meters in depth shall have a flagging tape barrier around the excavation if a dangerous condition is likely to. Any excavation deeper than 1.2 meters should have rigid barricading (by scaffolding pipe or other suitable material) all around. Starter bars and rebar up-stands shall be covered with a suitable caps n order to protect workers who may fall against or on them.

Excavations left open for longer than one day shift will be clearly identified by flashing lights at night where the excavation is located near vehicle or pedestrian access ways or is in a position which could cause danger to personnel working after dark.

Barricades with warning devices and flashing lights as needs shall be installed alongside of excavations wherever people or vehicles are exposed. Stop logs shall be used in areas where mobile equipment is being manoeuvred.

4.3 Placement & Removal of Soil

Soil removed from any excavation will not be left in close proximity to the excavated area; a minimum distance of 1 meter will be kept as an exclusion zone for the placement of spoils. Rocks, stones or other debris will not be left any closer than 2 meters to the edge of the excavation.

In case it is practical spoils will be removed from the excavation on a daily basis. All excavations must be inspected after rains, floods or other inside water accumulation. The spoils will be stored in a designated area, and the area should be protected to prevent debris flying around site.

All spoils will be removed and disposed in accordance with the Environmental Management Plan (Doc. No. 5578-E4-HSE-HU-00005).

4.4 Equipment/ Materials

All heavy equipments (e.g. compressor units, generators, etc.) shall be kept a minimum of 2 meters away from the edge of an excavation. As a general rule of thumb, no materials shall be placed within the distance equal to the depth of the excavation to ensure an angle of repose of 45° of the downward pressure the material will exert on the ground.

Wheel locks are to be placed on any wheeled vehicle or equipment which is parked in close proximity to an excavation. Heavy vehicular traffic shall not be permitted near un-shored sides. The location of underground utilities shall be identified prior to any excavation with necessary precautions taken.

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A trained banksman, wearing a high visibility vest, shall be present at all times during operation of the equipment. The operating area of the equipment shall also be cordoned off and only authorized persons will be allowed to enter into this area.

4.5 Protection from Cave-ins

Persons working in any excavation, including trenches that is 1.2 meter or more in depth must be protected from cave-ins by shoring/ trench boxes, benching or sloping.

4.5.1 Sloping and Benching

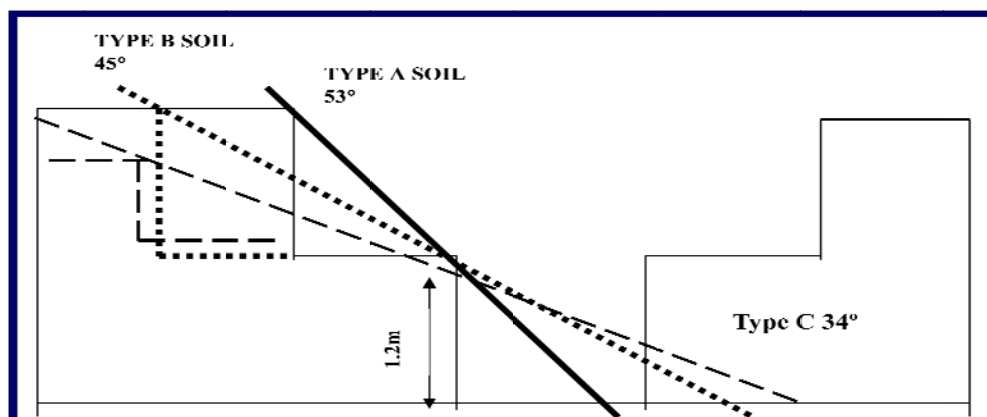
The design of protection systems, including sloping, benching, shoring and shielding, will depend primarily on two factors:

- The types of soil encountered, and
- The depth of the excavations

Persons working in excavations can be protected by sloping and benching the sides of the excavation in accordance with the table and drawing below.

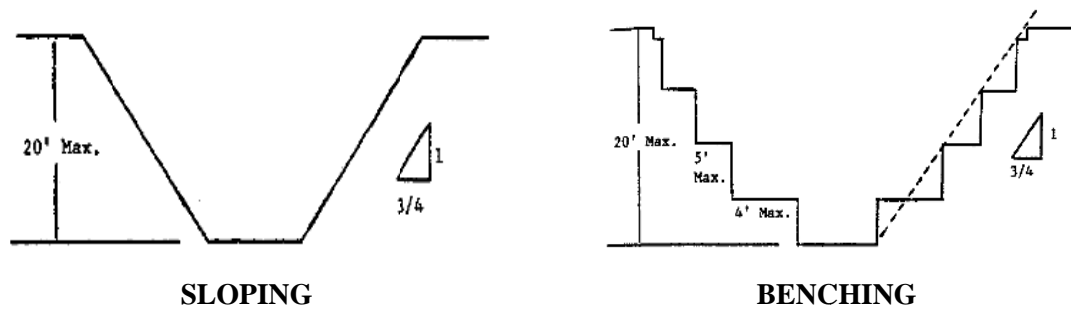
	Type	Slope	Maximum degrees
Soil	Wet soil (Type C)	1 : 1 ~ 1 : 1.5	45° ~ 34°
	Dry soil (Type B)	1 : 0.5 ~ 1 : 1	63° ~ 45°
Rock	Weathered rock (Type A)	1 : 0.8	51°
	Loose rock	1 : 0.5	63°
	Stable rock	1 : 0.3	73°

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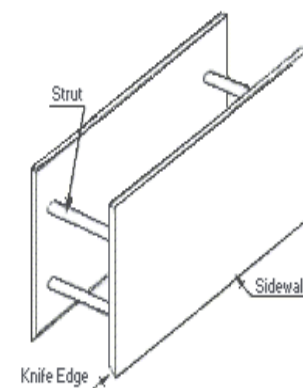
Examples of sloping and benching are given in below drawings;



4.5.2 Shoring and Shielding System

In case sloping or benching of excavation sides is not done, workers must be protected by shielding or shoring in excavations over 1.2 meters or deeper.

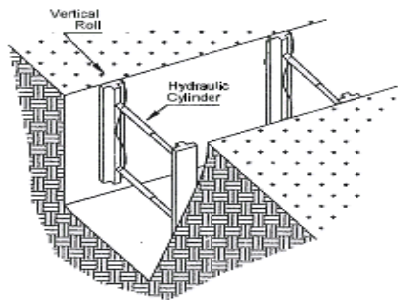
Shielding is a structure that is able to withstand the forces imposed on it and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either pre-manufactured or job-built in accordance with the relevant law; shields used in trenches are usually referred to as “trench boxes” or “trench shields” (See picture below).



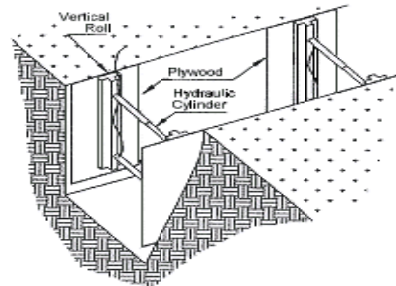
TRENCH BOX

Shoring is a structure such as a metal hydraulic, mechanical or timber sharing system that supports the sides of an excavation and which is designed to prevent cave-ins (see pictures below).

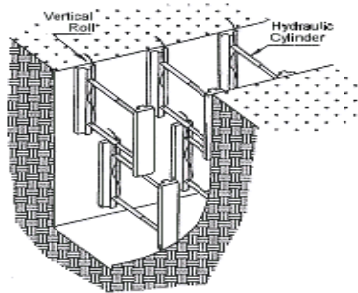
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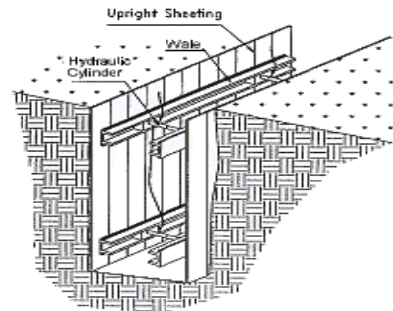
Vertical Aluminum Hydraulic Shoring
(Spot Bracing)



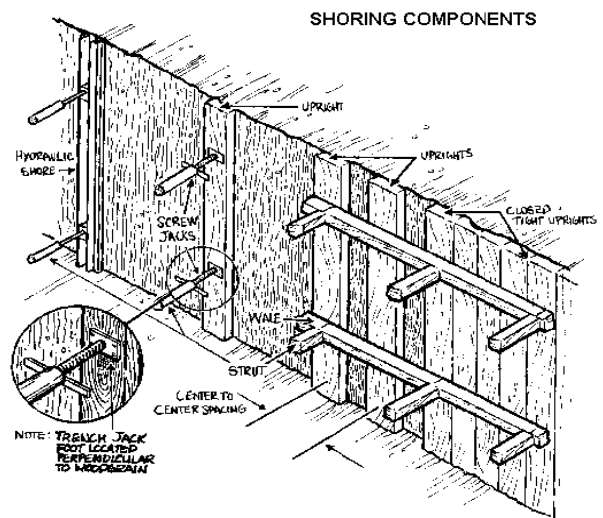
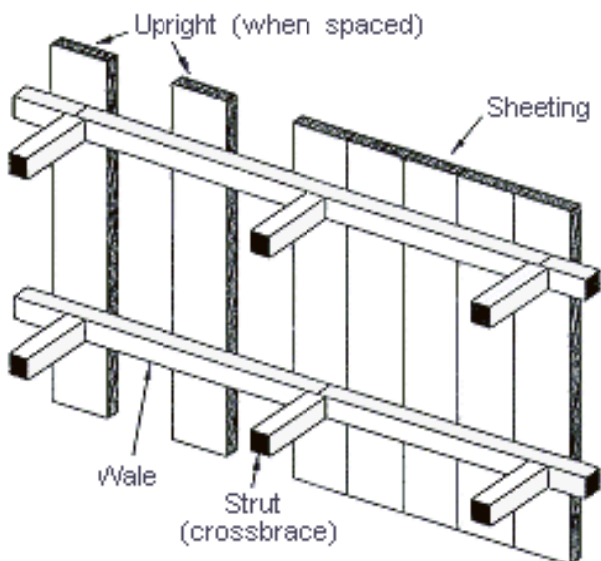
Vertical Aluminum Hydraulic Shoring
(With Plywood)



Vertical Aluminum Hydraulic Shoring
(Stacked)



Aluminum Hydraulic Shoring Waler System
(Typical)



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4.6 General Control Measures

The following general control measures have to be followed in case work is being done on excavations;

- Personnel working in the area of the excavation must wear personal protective equipment as indicated by the accompanying Permit to Work.
- Warning Notices and barriers must be erected, sufficient to avoid accidental entry, exclude unauthorized personnel and keep traffic and heavy equipment at a safe distance.
- Excavation equipment must only be used by persons trained in its correct use.
- Equipment shall have valid inspection certificates.
- Powered equipment must not be left running unattended.
- Only beaded or blunt edged tools may be used to excavate down to cable cover or tiles.
- Work must cease immediately if a cable tile or cover is encountered unexpectedly.
- Cable tiles or covers should be removed only on the authority and in the presence of an authorized person.
- Earth supports must be designed and constructed robustly. They may be erected, modified and dismantled only under the direct supervision of fully experienced and competent personnel.
- The minimum distance between the toe of an earth pile and the edge of a trench must be at least 1.5 times the depth of the trench.
- Temporary crossing over excavations must be constructed at least 0.7 meters wide and sufficiently strong for the span. There must be a railing on one side if there could be a fall of more than one meter or the trench is more than 0.7 meters wide.
- Access ladders must be properly fixed.
- Gas tests must be carried out as required by and noted on the relevant permit to work forms.
- Excavations shall be barricaded off and warning lights placed at night if so required.
- Sharp pointed steel tools may be used, with great care, to break the surface to a depth of 75mm, after which no picks or sharp pointed tools may be used.
- In case of doubt, a cable scan must be carried out and drawing checked prior to work commencing, and permit signed by the Authorized Electrical Person.

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5. TRAINING

All employees who are to be engaged in excavation works which consists of excavations deeper than 1.2 meters shall undergo the excavation safety training program. The training program will cover the following topics as a minimum;

- PTW requirements for excavations
- Shoring, benching, sloping or shielding.
- Removal of spoils.
- Exclusion zones for machines & equipment alongside excavations.
- Unstable soil.
- Leaching of water through excavation walls.
- Access and egress.
- Placement of material into excavation by cranes or other machinery.