DEP 34.18.51.10-Gen.June 1985MANUAL

MINIMUM REQUIREMENTS FOR THE CONSTRUCTION AND MAINTENANCE OF TANK FOUNDATIONS, BUND WALLS AND DRAINAGE SYSTEMS FOR SMALL STORAGE INSTALLATIONS

DEP 34.18.51.10-Gen.

June 1985

DESIGN AND ENGINEERING PRACTICE

USED BY

COMPANIES OF THE ROYAL DUTCH/**SHELL** GROUP

PREFACE

DEP (Design and Engineering Practice) publications reflect the views, at the time of publication, of:

Shell International Oil Products B.V. (SIOP)

and

Shell International Exploration and Production B.V. (SIEP)

and

Shell International Chemicals B.V. (SIC)

The Hague, The Netherlands,

and other Service Companies.

They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Group Operating companies. Where appropriate they are based on, or reference is made to, national and international **standards** and codes of practice.

The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use DEPs they shall be solely responsible for the quality of work and the attainment of the required design and engineering **standards**. In particular, for those requirements not specifically covered, the Principal will expect them to follow those design and engineering practices which will achieve the same level of integrity as reflected in the DEPs. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal or its technical advisor.

The right to use DEPs is granted by SIOP, SIEP or SIC, in most cases under Service Agreements primarily with companies of the Royal Dutch/**Shell** Group and other companies receiving technical advice and services from SIOP, SIEP or SIC. Consequently, three categories of users of DEPs can be distinguished:

1) Operating companies having a Service Agreement with SIOP, SIEP, SIC or other Service Company. The use of DEPs by these Operating companies is subject in all respects to the terms and conditions of the relevant Service Agreement.

2) Other parties who are authorized to use DEPs subject to appropriate contractual arrangements.

3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) or 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant **standards**.

Subject to any particular terms and conditions as may be set forth in specific agreements with users, SIOP, SIEP and SIC disclaim any liability of whatsoever nature for any damage (including injury or death) suffered by any company or person whomsoever as a result of or in connection with the use, application or implementation of any DEP, combination of DEPs or any part thereof. The benefit of this disclaimer shall inure in all respects to SIOP, SIEP, SIC and/or any company affiliated to these companies that may issue DEPs or require the use of DEPs.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, DEPs shall not, without the prior written consent of SIOP and SIEP, be disclosed by users to any company or person whomsoever and the DEPs shall be used exclusively for the purpose for which they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of SIOP and SIEP. The copyright of DEPs vests in SIOP and SIEP. Users shall arrange for DEPs to be held in safe custody and SIOP or SIEP may at any time require information satisfactory to them in order to ascertain how users implement this requirement.

All administrative queries should be directed to the DEP Administrator in SIOP.

NOTE: In addition to **DEP publications** there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

This manual gives guidelines for the design, construction and maintenance of tank pads and foundations, bund walls, drainage systems, pavings/sealing and other measures required in connection with possible pollution caused by spillage or calamities.

It is applicable for tanks containing product under atmospheric pressure conditions, i.e. not for LPG storage facilities etc.

It is intended for use by (small) organizations such as some marketing companies who normally do not have the support of a civil engineering department or a civil maintenance engineer.

The information contained in this manual is supplementary to the following civil engineering DEPs :

Site investigations	DEP 34.11.00.10-Gen.
Site preparation and earthworks	DEP 34.11.00.11-Gen.
Geotechnical and foundation engineering Roads, paving, surfacing, slope	DEP 34.11.00.12-Gen.*
protection and fencing	DEP 34.13.20.31-Gen.
Refinery drainage systems	DEP 34.14.20.31-Gen.

In addition to these requirements, all activities shall be carried out in accordance with recognized and accepted theories, methods, codes of practice, **standards** and good engineer- ing practice.

Unless otherwise authorized by SIPM, the distribution of this manual is confined to companies belonging to or managed by the Royal Dutch/**Shell** Group, and to contractors nominated by them.

As a rule the requirements of this manual shall be adhered to. However, national and/or local regulations may exist in which some of the requirements are more stringent.

The contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, economic and legal aspects.

All publications referred to in this manual are listed in (9.).

Where cross references are made, the number of the (sub)section referred to is shown in brackets.

* In course of preparation

2. DEFINITIONS

For the purpose of this manual the following definitions shall have the meaning:

Shall and Should - The word 'shall' is to be understood as mandatory and the word 'should' as strongly recommended to comply with the requirements of this manual.

The Principal is the party which initiates the project and ultimately pays for its design and construction.

The Principal will generally specify the technical requirements.

The Principal may also include an agent or consultant, authorized to act for the Principal.

The Contractor is the party which carries out all or part of the design, engineering, procurement, construction and commissioning for the project.

The Principal may sometimes undertake all or part of the duties of the Contractor.

3. TANK BUNDS

3.1 GENERAL

The function of a tank bund is to control spillages from any tank in that bund such that subsequent damage to the tank, its contents, adjacent tanks and surrounding areas is minimized.

Tank bunds, tank farms and bunded areas shall be designed in accordance with DEP 34.11.00.11-Gen. and the IP Model Code of Safe Practice, Part 3 - Refining Safety Code. This includes tank lay-outs, safety distances and bund capacities.

Note: By marketing companies the 'European Model Code of Safe Practice, Part II is normally used.

The IP Safety Code states that the net capacity of a tank bund (compound) formed within the main fire wall should be sufficient to provide reasonable protection against possible escape of products beyond those walls.

Reasonable protection in terms of volume is considered to be when the bund has a net volume capacity equal to the volume of the largest tank in that bund.

The total volume of the bund should be calculated by adding to this net volume capacity the following volumes insofar as these volumes are below the top level of the surrounding bund wall:

- the volume of the tanks except of the largest tank in that bund

- the volume of all tank pads

- the volume of all intermediate fire walls.

In larger bunded areas intermediate fire walls may be designed, normally not higher than 0.6 m, to act as firebreaks and to divide the tankage into groups of a convenient size.

Lay-out sketches for various tank configurations are shown in Appendix 1.

3.2 IMPOUNDING BASIN

If the bund cannot be made large enough to contain the volume in accordance with the rules set out in (3.1), a suitable depression or a purpose-made impounding basin can be used conveniently situated elsewhere within the installation.

This impounding basin has to be connected to the tank farm(s) by a sufficiently sized underground drain line, with open catch basins at either side.

Pumping facilities normally have to be incorporated to pump out rain water regularly from this impounding basin.

4. BUND WALLS

4.1 BUND WALL DESIGN

Bund walls shall be designed and constructed as a low- permeable earthen or clay structure with a slope not steeper than 1:1. For detailed design, see DEP 34.11.00.11-Gen and Standard Drawing S 12.002.

4.2 BUND WALL COVERING

The bund wall cover has a double function:

- protection against erosion of the bund wall body

- impermeabilization of the bund wall.

For preferred options of the covering details see (6.2.3) and (6.2.4) of DEP 34.11.00.11-Gen., and Standard Drawing S 12.002.

The consequences of possible seepage through and/or under the bund wall shall be investigated and, if required, appropriate measures shall be taken. In this respect, penetration of the earthen bund wall or the subsoil under the bund wall by e.g. pipes or cables shall be avoided, or adequate measures shall be taken.

If, for some reason, i.e. chemical or light product storage, a rigid (concrete) bund wall covering has to be chosen, a woven filter cloth shall be carefully applied under all joints, weep holes and areas of potential cracking to prevent wash-out of fine materials, see Standard Drawing S 12.001, details 3 and 4. All joints have to be filled with a suitable mastic and regular inspection and maintenance have to be carried out to seal occurring cracks in order to prevent wash-out and cavity-forming under the covering.

For minimum slab thickness, reinforcement and maximum panel sizes, see (6.4.1.1) of DEP 34.13.20.31-Gen.

4.3 REINFORCED-CONCRETE/SHEET PILE RETAINING WALLS

At some locations, i.e. next to pump floors where many pipes have to cross the bund wall or where very little room is available for the bund wall, a reinforced concrete retaining wall or steel sheet pile retaining wall may have to be installed instead of the standard bund wall.

When designing this retaining wall, attention shall be paid to the stability, the panel joints (water stops) and the seepage under the wall.

Appendix 2 shows the effect of sheet pile retaining walls for different soil situations. By introducing a sheet-pile wall under the retaining wall floor the seepage in (a) is almost reduced to nil and in (b) the flow is greatly reduced.

If sheet piling is used for a bund wall, it may be necessary to seal the joints between the piles, e.g. by means of epoxy coal tar.

In addition, the application of a reinforced concrete capping on top of the sheet piling may be required in order to reduce deformation/deflections of the wall when retaining liquid which could lead to increased seepage through the joints.

5. BUND FLOORS

The degree of impermeabilization required depends on the product stored in the tanks, on local circumstances and laws, and shall be agreed by the principal.

The impermeabilization is not normally continued underneath the tank pads, because if the tank pads were to become saturated with e.g. rain water or product from the tank, this might unacceptably influence its stability and settlement behaviour. For further design requirements see DEP 34.11.00.11-Gen.

Soil and water pollution shall be avoided under all circumstances.

However, if owing to malfunctioning or misoperation product has leaked into the porous subsoil, adequate measures shall be taken to prevent the spreading of the product via the groundwater and the subsequent pollution of groundwater and surface water outside the installation.

Suitable oil recovery systems can be installed (by specialist firms), e.g. systems for well recovery using water-table depression, causing oils and water to flow to the well. In this way the oil can be recovered and will not pollute a big area.

Polluted soil can also be cleaned. For further information specialists should be consulted.

6. TANK PADS

6.1 GENERAL

Foundations for vertical (atmospheric) storage tanks generally take the form of a tank pad, constructed from durable, inert, granular materials, such as crushed rock, coarse sand, etc. These materials shall have the following properties : good permeability, 'incompressible', high friction, easy to compact.

The tank pad shall be covered by a protective layer.

Atmospheric storage tanks are rarely founded on piled-concrete foundations, unless the predicted differential and total settlements and tilt exceed the limits set for the tank in question, see (7.). In exceptional cases for small tanks a concrete raft is sometimes used as a foundation.

Anchor bolts may be required to hold the tank wall down (e.g. in earthquake areas or where internal tank pressure is high, e.g. for BHC tanks) in which case a reinforced concrete ring beam or other appropriate solutions may be required, see (6.4.2) and DEP 34.51.01.31-Gen.

The following paragraphs deal only with tank pads consisting of granular materials. Application of non-granular materials for tank pads or unpiled concrete raft foundations is in principle not allowed.

6.2 TANK PAD FUNCTIONS AND REQUIREMENTS

The functions of a tank pad are :

- To spread and transfer the load from the tank and its contents via the tank pad body and shoulder to the subgrade such that the resulting settlements, both total and differential, remain within allowable limits.

- To raise the tank bottom above ground water, capillary water, surface water and minor spillages.

- To provide a smooth surface with sufficient bearing capacity for tank construction.

The requirements of the shoulder to the tank pads are :

- To provide sufficient lateral support to the tank foundation under all conditions. The shoulder shall be capable of resisting damage due to construction, operating and maintenance activities.

- To resist edge cutting beneath the tank **shell**.

- To resist wash-out of the tank foundation as a result of tank bottom leakages and possible ingress of water.

6.3 DESIGN OF TANK PAD

6.3.1 Soil investigations

The initial tank pad profile (cone up and subsequent cone- down) has to be chosen as a result of the settlements and stability calculations. The calculations shall be based on the results of a soil investigation and shall be agreed by the principal. The properties of the existing subsoil shall be thoroughly investigated, if no adequate information is already available.

This soil investigation shall consist of a number of Dutch Cone Penetration Tests (DCPT), or alternatively

Standard Penetration Tests (SPT) if DCPTs cannot be carried out, borings and laboratory tests of samples taken from the boreholes to determine the physical, mechanical and chemical properties of the soils at various depths.

This investigation shall be carried out by a reputable geo- technical firm. This firm should have experience with local soils and with tank foundations, in order to give proper advice after testing of the subsoil. This advice shall at least cover:

- the time-settlement behaviour of tank pad and tank

- the tank shoulder width

- the required compaction of tank pad and shoulder

- maximum tank height

- maximum water fill rate and

- total hydrostatic test time.

The required number of DCPTs or borings (SPTs) depends on the diameter of the proposed tank.

In general, a number of DCPTs will be done on the theoretical tank pad circumference at approx. 10 m centre to centre and only one near the centre (for smaller tanks), together with one or two borings. The required depth of DCPTs normally depends on the tank diameter and subsoil conditions.

This is especially important under large tanks, as the influence of the increase in depth effect of soil pressure is a function of the surface area, as shown in Appendix 3. Tanks of the same height but with different diameters will have very different settlements as a consequence of depth effect in soil pressure increase.

In the hatched areas an increase of the soil pressure of more than 10% will occur.

The extent of this influence is between 1 and 2 times the diameter of the tank, depending on the type of soils. With homogeneous soil, the difference will be smaller than with deep weak layers such as a peat layer. See Appendix 3.

6.3.2 Pad shoulders

Pad shoulders should be wide enough and properly compacted under the annular plate, under the tank **shell** and near the tank (to higher values than under the tank), in order to reduce the bearing pressure on the subsoil by spreading of the load. This is especially important on soft silts or clays.

At the same time the wide-compacted shoulder gives lateral support to the concentrations of stress in the soil below the tank **shell**.

This can be seen in sketches below :

a) depicts a shoulder which is too narrow, where soil movement under the **shell** or even a slip failure is likely to occur

b) depicts a shoulder which is wide enough, but not sufficiently compacted. Consequently, the angle of internal friction of the shoulder material is low and a slip failure could occur. Settlements and differential settlements will also be experienced

c) depicts a wide, sufficiently compacted shoulder with no risk of soil movement or a slip failure of the shoulder.

6.3.3 Tank (bottom) settlement

As a general rule, one must assume that the tank centre will settle substantially more than the tank edge because of variation in stress distribution.

After settlements due to hydrostatic testing and a number of years of operational service, the remaining minimum elevation of the tank pad measured at the position of the tank wall shall be 0.60 m above the highest floor level of the bunded area.

During hydrostatic testing of the tank, 30 to 70% of the total settlement will take place already and the remaining settlements will take place mainly during the first few years when the tank is in operation.

Settlements will gradually become less, as can be seen in the typical settlement curve below.

Settlement curve of tank edge

Where no great settlements are to be expected, the tanks are built with a cone-down of the bottom and a centre drain connection.

Where great settlements are to be expected, a bottom cone up can be made.

The slope of the bottom shall not exceed 1:120 and the maximum cone up in the centre shall not exceed 300 mm in order to reduce the possibility of rippling of the tank bottom. It may be necessary to install side drains in addition to the centre drain, depending on the prediction whether after the tank settlement during the hydrostatic test a bottom cone up still remains.

For details of side drains see Standard Drawing S 51.088.

6.4 CONSTRUCTION OF TANK PAD

6.4.1 General

Tank pad materials shall be selected, placed and compacted in accordance with DEP 34.11.00.11-Gen.

After construction of the tank pad body, the degree of compaction of the placed and compacted material shall be checked, preferably by means of DCPT.

These DCPTs shall be done with the following minimum frequencies:

- 3 DCPTs for tanks up to 15 m diameter
- 5 DCPTs for tanks up to 50 m diameter
- 9 DCPTs for tanks above 50 m diameter.

The penetration depth shall be between 3 and 5 m under the foundation level in order to confirm also the condition of the subgrade immediately below the tank pad.

Typical examples of required DCPT values to be reached :

Depth underneath top tank pad (m)	Tank: D=12 m, H=10 m Min. DCPT value in MN/m_2	D=60 m, H=24 m Min. DCPT value in MN/m_2
0.25	4.0	7.0
0.50	5.5	8.5
0.75	6.0	9.0
1.00	6.5	9.5
1.50	7.0	10.0
2.00	7.5	10.5

See Appendix 5 of DEP 34.11.00.11-Gen. for intermediate values.

6.4.2 Concrete foundation ring under the tank shell

A concrete foundation ring under the tank **shell** shall be used only when a downward force is required to compensate for wind and the uplift caused by internal pressure, e.g. for BHC and BHD tanks (see DEP 34.51.01.31-Gen., Section 3).

Where this condition does not exist, concrete foundation rings should not be used, as they create a hard spot under the tank **shell** and bottom (annular) plates which may result in unacceptable differential bottom settlements within short distances. This could result in leaking of the tank bottom through cracks in plates.

If this risk exists owing to expected settlements, concrete slabs shall be used to prevent a sharp transition. See Appendix 4 for a typical section.

When concrete foundation rings are used, the top of the ring shall be covered with a bitumen layer of at least 5 mm to prevent corrosion.

A stability calculation shall be made to determine the number of anchor bolts.

6.4.3 Gravel backfill under tank shell/annular plate

A foundation ring (i.e. the shoulder and the zone under the tank **shell**) constructed from crushed rock would be preferable (over sand). This material has a greater resistance to edge cutting and damage during construction.

The tank pad body (inside this ring) may be constructed from finer granular material, such as sand, provided that a filter is installed between the sand body and shoulder material in order to prevent wash-out. See also detail 1 on S 12.001.

6.4.4 Concrete rafts

For small tanks a concrete raft is sometimes used as a foundation. In this case the top of the concrete raft shall be covered with a layer of sand-bitumen mixture of at least 50 mm to allow movement of tank bottom and to prevent corrosion.

Possible settlements and differential settlements, stress distribution under the slab, and the strength of this slab, taking into account final settlement, shall be taken into consideration.

6.5 TANK PAD FINISHES

6.5.1 General

The functions of the tank pad covering under the tank are:

- to protect the tank pad during construction of the pad

- to promote a uniform distribution of stress

- to act as a barrier to corrosion promoted by water or water vapour together with chemicals which may be present in the tank pad or subsoil.

The functions of the covering of the tank foundation shoulder are :

- to protect the foundation from damage resulting from weathering and erosion

- to protect the foundation from damage due to construction, operation and maintenance activities.

6.5.2 Materials and construction

The finish under the tank shall be a sand-bitumen mix.

For design and placing see Appendix 3 of DEP 34.11.00.11-Gen.

The tank pad shoulder may be covered by a sand-bitumencement (lime) mix (i.e. wet-sand mix), a (hot) sand-bitumen mix, or if the chance of a light hydrocarbon/chemical spill is not remote, a concrete covering may have to be applied consisting of loose elements or tiles.

In the latter case, the sand-bitumen layer has to protrude slightly (say 150 mm) beyond the bottom plates of the tank and, after completion of the tank construction and testing, this ring has to be filled carefully with bitumen to minimize corrosion of the bottom plates. The shoulder finish should have a slope of 1 : 10 from the underside of the steel bottom of the tank, in accordance with Standard Drawing S 12.001, to avoid ingress of water under the tank after some tank settlement has occurred.

Note: For design and placing of wet-sand mix see Appendix 4 of DEP 34.11.00.11-Gen.

7. TANK MAINTENANCE

For tank maintenance see DEP 70.51.10.11-Gen. From this DEP the following is highlighted.

Maximum allowable sag in the tank bottom (after settlement) See Section 9.5 of the above DEP.

The maximum sag f should not exceed the value derived from the following equation :

where

f = max. allowable sag in tank bottom in m

D = diameter of tank in m

f_o = deflection of bottom centre in m, in relation to bottom edge when the tank erected (positive, zero or negative).

Note: It is recommended to use a safety factor of 2 for this formula, in view of possible reduced thickness (corrosion) and distortions.

Maximum allowable uneven settlement (tilting)

See Section 9.6 of the above DEP.

Before these maximum values are reached, the tank should be lifted (that is, jacked up by a specialist contractor) and the foundation repacked.

It is not always necessary to lift the tank completely. For instance, when a floating roof tank becomes too oval because of partial settlement of the tank wall, it may be sufficient to lift the tank wall only to such a level that the top of the **shell** is round again.

The space under the outer 2-4 m of the tank bottom, which is lifted off the tank pad in this way, can be filled with clean dry sand which is blown or manually inserted into this space.

After this exercise it will be necessary to relevel and resurface the tank shoulder.

For requirements regarding tolerances in tank constructions, acceptability criteria at inspections and allowable deformations after hydrostatic testing, reference is made to DEP 64.51.01.31-Gen.

8. DRAINAGE OF BUNDED AREAS

Drainage of bunded areas should normally be arranged as described in Section 5.1 of DEP 34.14.20.31-Gen.

These arrangements can, however, pose problems in unmanned depots. In areas with substantial rainfall, some measures should be taken to prevent flooding of the normally closed, bunded area to such an extent that saturation of bund walls and tank pads can occur.

For unmanned depots or depots left unattended at weekends, arrangements have to be made for a nominated responsible person to enter the depot and drain the bund(s) through the interceptor valve.

One could for instance also consider remote electrical level control indicators.

9. REFERENCES

In this manual reference is made to the following publications.

Note: The latest issue of each Group publication should be used together with any amendments, supplements and/or revisions.

It is particularly important that the effect of revisions to international, national or other **standards** shall be considered when they are used in conjunction with DEPs, unless the standard referred to has been prescribed by date.

DEPs	
Site investigations	DEP 34.11.00.10-Gen.
Site preparation and earthworks	DEP 34.11.00.11-Gen.
Geotechnical and foundation engineering Roads, paving, surfacing, slope	DEP 34.11.00.12-Gen.*
protection and fencing	DEP 34.13.20.31-Gen.
Refinery drainage systems	DEP 34.14.20.13-Gen.
Standard vertical tanks design and fabrication	DEP 34.51.01.31-Gen.
Standard vertical tanks - Erection and testing	DEP 64.51.01.31-Gen.
Field inspection methods and repairs of vertical steel storage tanks	DEP 70.51.10.11-Gen.
STANDARD DRAWINGS	
Tank foundation	S 12.001
Bund wall, typical details	S 12.002

Typical side drain with sump	S 51.088

OTHER **STANDARDS**

IP Model Code of Safe Practice	Part 3 Refining Safety Code

Issued by

Institute of Petroleum,

61 New Cavendish Street,

London W1M 8AR, UK

* In course of preparation

European Model Code of Safe Practice in the storage and handling of petroleum products	Part II

Issued by

Applied Science Publishers LTD

Ripple road,

Barking, Essex,

England

10. APPENDICES

Lay-out sketches of tank farms with safety distances	Appendix 1
Reinforced-concrete retaining walls with sheet piling	Appendix 2
The effect of tank dimensions on soil settlement	Appendix 3
Typical section of concrete foundation ring with concrete slab	Appendix 4

APPENDIX 1 LAY-OUT SKETCHES OF TANK FARMS WITH SAFETY DISTANCES (FROM IP CODE)

TANKS FOR PETROLEUM STOCKS OF CLASSES I, II AND III (2)

LAY-OUT SKETCHES OF TANK FARMS WITH SAFETY DISTANCES (FROM IP CODE)

TANKS FOR PETROLEUM STOCKS OF CLASSES I, II AND III (2) (cont'd)

Note: The lay-out and distances as indicated in the above figures may differ from those indicated in the 'European Model Code' or '**Shell** Marketing Safety Code, section 05.00.00.

APPENDIX 2 REINFORCED-CONCRETE RETAINING WALLS WITH SHEET PILING

APPENDIX 3 THE EFFECT OF TANK DIMENSIONS ON SOIL SETTLEMENT

APPENDIX 4 TYPICAL SECTION OF CONCRETE FOUNDATION RING WITH CONCRETE SLAB