Guidelines for urban engineering geological investigations in South Africa

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Abstract These guidelines endeavour to provide a standard by which engineering geological investigations for urban development should be carried out. The investigations for urban development can be divided into three different categories, namely: investigations for planning, investigations for urban development and specialized geotechnical investigations. The minimum requirements for the planning and urban development investigations are listed. These guidelines suggest the level at which the various types of investigation should be carried out as well as the range of application, the scope and the methodology to be used for the different investigations. It is hoped they will provide guidance to both practitioners and clients on the importance and application of engineering geology in the establishment of new urban development.

Introduction

Since the first democratic government in South Africa was elected in April 1994 a so-called Reconstruction and Development Programme (RDP) was set in motion to address some of the problems of the apartheid era. This RDP is an integrated, coherent socio-economic policy framework that seeks to mobilise all the people and the country’s resources to build a democratic, non-racial and non-sexist future. It has been drawn up by the African National Congress (ANC)-led alliance in consultation with other key mass organisations and with assistance from a wide range of non-governmental and research organisations (African National Congress 1994).

Among its five key programmes is that of meeting basic needs, an essential part of which is clearly the provision of housing, drinking water and sanitation. The housing backlog is such that vast areas of land are needed for the construction of houses. Due to the rapid urbanisation of the recent past, most of the best land suitable for development in close proximity to urban centres has been exhausted. Geologically safe sites have to be found and investigated before private and governmental agencies are prepared to finance such projects. It is stated in the Development Facilitation Act (DFA) of 1995 that laws should ensure the safe utilisation of land by taking factors such as geological formations and hazardous undermined areas into consideration. The sustained protection of the environment should also be promoted.
Some of the regulations of the DFA state that the land development applicant must include in his or her application an initial geotechnical assessment. Two other guidelines and code of practice documents were published in support of the DFA and its regulations: the Code of Practice for Foundations and Superstructures for Single Storey Residential Buildings of Masonry Construction, which was published through a joint effort of the South African Institution of Civil Engineers and the Institute of Structural Engineers (1995) and the National Home Builders Registration Council’s Standards and Guidelines document (NHBC 1995). These documents list typical founding materials with expected soil movement for each material type and suggested foundation designs and building procedures for each class of structure. These proposed foundation solutions are reflected as construction requirements. Geotechnical constraints on urban development should therefore be identified and understood so that: (1) the constraints are considered at an early stage in the planning and design of urban areas; (2) the impact of urban development on the environment can be better understood and provided for; and (3) non-renewable resources such as building sands and brick-making clays are not misused by such development.

Historical background

The first legislation in which geotechnical aspects of land development were addressed was the Transvaal Provincial Ordinance 25 of 1965 (Province of Transvaal 1965). Regulation 24(b) of this Ordinance stipulates that the Townships Board must report on the “suitability of the site with respect to the area, position, water supply, soil, aspect, contours, danger of flooding, the presence of dolomite rock (karst), possibility of extension, grade of streets, accessibility and any other circumstances that may affect the proposal to establish a township”. The karst stability aspect and recommendations regarding geotechnical investigations for urban expansion have been referred to the Geological Survey of South Africa (presently the Council for Geoscience). The geological report has to zone the proposed area earmarked for development into zones suitable for different types of land-uses, e.g. special residential, general residential, industrial, sport and recreation and unsuitable for development. The final decision on township layout rests with the Director of Local Government, with his recommendations incorporated in the conditions for township establishment.

This 1965 Ordinance was replaced in 1986 with the Transvaal Provincial Ordinance 15, which came into effect on 10 June 1987. It applies to all township applications submitted since that date. It was intended “to consolidate and amend the laws relating to town-planning and the establishment of townships; and to provide for matters incidental thereto”. Regulation 18(1) states “an application for the establishment of a township in terms of Section 69 or 96 of the Ordinance shall be accompanied by ... (b) a detailed report with comprehensive motivation relating to ... (ii) the design and end use of the erven (land parcels) and streets in the township with special reference to ... (cc) how the township will be affected by ... (bbb) geotechnical conditions ...”.

The Less Formal Townships Establishment Act no. 113 (1991) came into effect on 1 September 1992. This act was specifically introduced to try to speed up the process of land provision for townships for less formal forms of residential settlement and to regulate the residential settlement of communities in tribal lands. According to Schedule 2(2) of this act, “every application shall, at the time it is lodged with the Administrator, be accompanied by ... (1) a copy of a geotechnical report ...”.

The Development Facilitation Act no. 67 (1995) came into effect on 28 September 1995 and has already been referred to above. Regulations specifically related to the required geotechnical assessment appear in Section 26 of Government Gazette no. 17395 of 30 August 1996 (Development Facilitation Act 1996). The following sub-sections are important:

1. The land development applicant shall include in his or her application, as set out in Annexure B, an initial geotechnical assessment.
2. The designated officer shall make a recommendation to the tribunal as to whether a comprehensive geotechnical report should be prepared.
3. The tribunal may, on the basis of the initial geotechnical assessment, impose an appropriate condition of establishment as contemplated in Section 32(2) or 51(2) of the Act; or require the land development applicant to prepare a comprehensive geotechnical report.
4. The costs of both the initial and comprehensive report shall be borne by the applicant.
5. The initial report shall indicate, on the basis of a desk study, excluding field work and utilizing information from maps, databank sources and, where relevant, interpretation of aerial photographs, the suitability of the proposed site for the planned development by reference to the following factors:
   a) whether the site is underlain by dolomitic rocks, and, if so, shall generally evaluate the risk of sinkhole and compaction subsidence (doline formation);
   b) whether the site is undermined, and, if so, the depth, geometry, etc. of the workings, and if affected by undermining, the risk of mining subsidence shall be generally assessed;
   c) whether the site is located on clays which will shrink and swell in response to changes in soil moisture, and, if so, the probable heave movement;
   d) whether the site is located on soils with a collapse of grain structure, and, if so, the probable magnitude of the settlement that could occur should these soils be saturated under load;
   e) the occurrence of seep areas and drainage channels;
   f) the position of the 1:50-year flood line;
   g) the occurrence of existing perched (and possibly future perched) and normal water tables;