

“HIGHLAND TOWERS COLLAPSED”, THE TRAGIC STORY OF MALAYSIA!

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Abstract

Highland Towers, as is collectively known, consist of three blocks 12 story high apartments named simply as Block 1, 2, and 3 respectively. It was constructed sometime between 1975 and 1978 and the residents who dwelled therein were middle income earners. Directly behind the 3 blocks was a rather steep hill with a stream flowing west, if it was allowed to follow its natural course. The attraction of this place was the natural surroundings with an extensive view of the city of Kuala Lumpur. Highland Towers collapse was caused by the instability of the pile foundation. The engineer was not considering the horizontal load during design foundation so when the rotational retrogressive slide occurs, this forward movement downhill created a surcharge load to the foundation. Since the foundation cannot resist horizontal load, it failed and as a result, the Highland Towers collapsed. Combinations of several factors were contributed to the tragedy of Highland Towers. Tragedies like this can be difficult to prevent. However, certain measures can be taken to protect buildings from landslides.

Keywords

Highland Towers, Collapsed, Caused, Tragedy, Landslide, and Control Plan, Malaysia.

Introduction

Although Malaysia is not a precipitous country (mountains and hills are less than 25% of the terrain), slope failures/landslides are a frequent fact there. From one aspect it seems, that the frequency of slope failures is due to the monopoly of the rainfall. The question is that, is rainfall is the only issue? In actual this is not the only justification and that's what author has explored through previous case studies or past researches. Most of the landslides emerges on manmade slopes and this is in essence the upshot of uncertainties related to human factors like insufficiency in design, failing in construction or wretched maintenance (Jamaluddin, 2006). One of the sectorial report of Malaysia clearly mentioned about 49 landslides cases out of which 88% are recognized with manmade slopes (JKR, 2009a, and b). Gue and Tan (2007) also declares that along with poor designing, incompetency, casualness, raw input data are also contributing in this frequent fact of landslides.



Role of human uncertainties is not unusual, (Holger et al., 2008) also documented the role of human uncertainties (by giving it the name of human factors) when discussed about design of coastal structures. In general, a human factor is a physical or cognitive property of an individual or social behaviour which is specific to humans and

influences functioning of technological systems as well as human environment. It is assessed that uncertainties are grown up from human factors. These “human factors” are thorny to weigh up during the design process but can cause pressure on structural integrity/safety. Reichart (1998) also defined design and construction errors as:

“A design and construction error has occurred whenever the analysis of the failure causes reveals that an information relevant for the avoidance of the failure was not available not used or wrongly used applied in the design of a construction phase of a component or a system”.



Landslide Case 1 (Highland Towers Collapse, 1993)

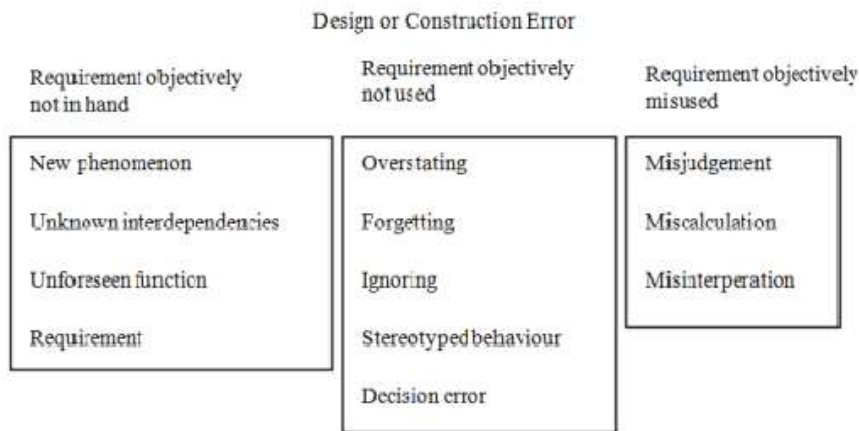
The Ulu Klang area has experienced several serious landslides since December 1993, when a Block of Highland Towers collapsed, causing a tragedy involving 48 deaths. The Highland Towers have three 12-storey blocks, constructed between 1975 and 1979 at the western base of a steeply sloped hill which was later terrace extensively in the starting of 1980s. Each block was respectively called Block 1 (built first, southern- most), Block 2 (built second, north-northwest of block 1, slightly elevated than the other two, closer in to the hill) and Block 3 (built last, northwest of block 1, west of block 2). The total length of landslide was 120 m and width of rupture surface was about 90 m involving round about 40,000 m³ of debris. Regarding this landslide the most authentic report has been produced by Ampang Jaya Town Council that (MPAJ, 1994) Highland Tower collapse main cause is inadequate drainage. From another aspect, design deficiencies are also found. The report has (MPAJ, 1994) following concluded factors responsible for this landslide (Jaapar, 2006):

- Buckling and shearing of rail piles foundation persuade by soil movement.
- Surface runoff due to improper drainage facility.
- Cut and fill slopes, rubble walls around Block I showed inadequate design (carrying safety factor <1) and poorly administered construction.
- Slope gradient is suspected to be very steep.
- No maintained drainage system along with leakage from pip.

From the computational analysis done by Prof Simon, (Nguee, 2006) revealed the facts that high wall has very low safety factor and the designed wall would fail at 5 m very simply even not including water pressure. The calculated safety factor of all those walls which were at the back of Block 1 is 1.52, even without allowing water forces at the back of the walls. It is also observed under the same study that wall composed of different size of

stones with haphazard plaster carrying no drainage blanket over it. A disquieting point was that it had no base, directly rests on ground.

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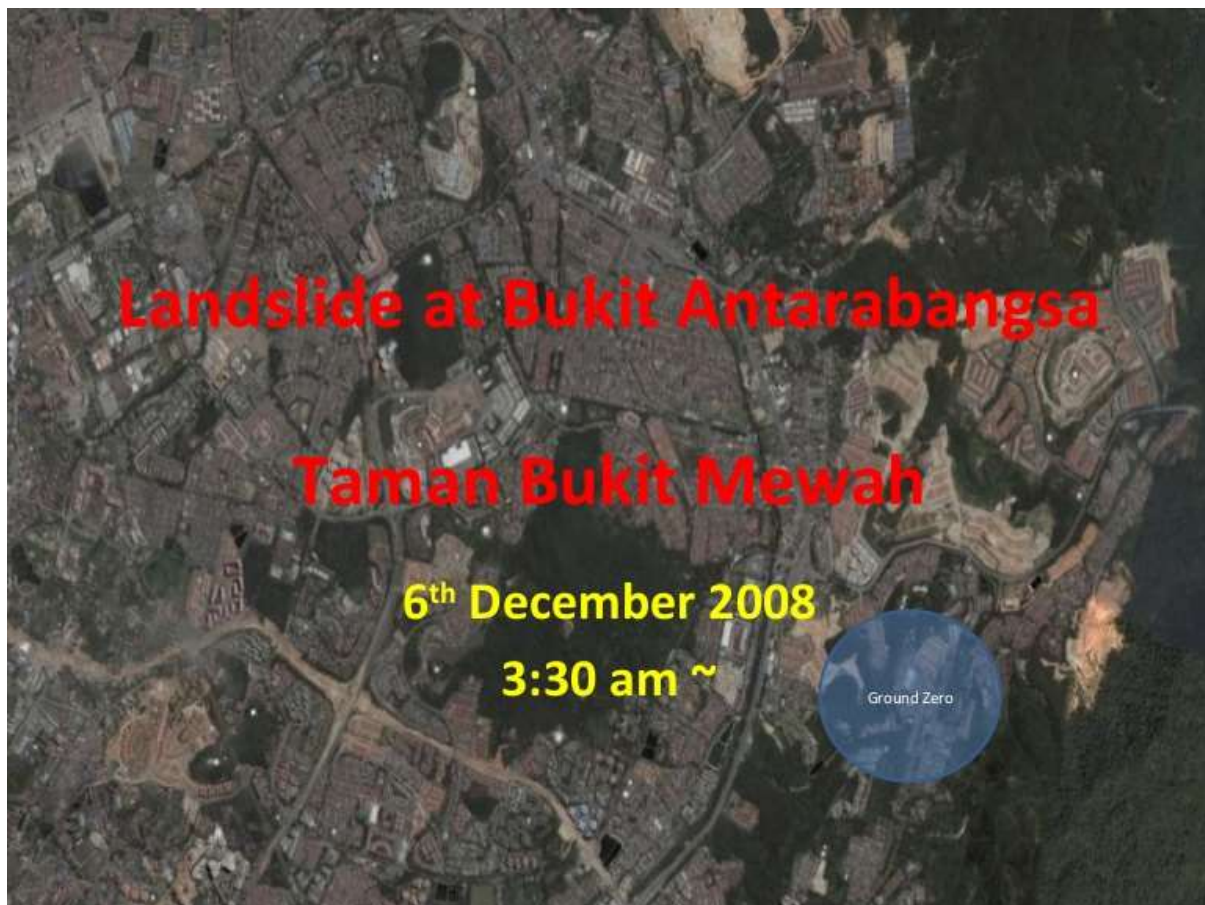


Landslide Case 2 (Bukit Antarabangsa, 2008)

On 6th December 2008, a landslide was occurred at Taman Bukit Mewah, Bukit Antarabangsa, Hulu Kelang, Selangor. The landslide took place around 3.30 a.m., having 109 m in width at the crest, 120 m in length, 15 m in depth and the angle of the scarp of the crown ranges from 45° to 50°. It was observed that 101,500 m³ of earth had translated and the maximum run out distance of the failure debris was 210 m from the toe of the slope.

MPAJ reported about Bukit Antarabangsa (2008), (quite latest landslide) that leaking pipelines near Jalan Wangsa 11 very close to the landslide area are responsible to build up water pressure in the soil pores. It is already pinpointed by the authorities that no signs of earth motion are shown in the seismic records so possibilities of

triggering this landslide due to earthquake forces are totally zero. Another aspect which is tried to pinpoint is that Bukit Antarabangsa is the outcome of pipe burst or calling it a rare event. In other words it's claiming that due to bursting of water pipe this landslide occurs. As already discussed by Harahap and Aini (2010) that this accident has been taken place after 20 years of project development and it's thought to be the result of pipe burst on hill top due to which landslide occurs. It's obvious that rare event theory is governing here as bursting of pipe is not a usual event plus it happens in peak monsoon season. All the facts and theories exist but this is only the superficial observation. Why bursting of pipe happens? Question is that, is it an accidental happening? Around the same area in 1999 an incident of landslide has been occurred but due to no fatalities it seems to be less debatable. If specifically referring the two case histories pinpointed by Bukit Antarabangsa (1999, 2008), one common feature is the poor or inadequate drainage. Clogged drains or even no sign of berms drain construction in Bukit Antarabangsa (1999). Landslides disasters for this particular area of Bukit Antarabangsa is not surprising as history shows (Table 1) that this area is very prone to slope failures. Sequential events relating to the site are as under: The 6th December 2008 landslide was heralded by a sequence of low rainfall events, which was having much less potential to trigger landslide. From the rainfall study, it is questionable that rainfall incident is the main triggering factor for this particular landslide of 6th December 2008. Other highly contributing factors such as the conditions of drainage, sub-soil, geology, groundwater, underground piping etc., ought to be investigated to find out the tangible origin of the landslide. It is confirmed through (Fatt and Fang, 2009), that Bukit Antarabangsa area had faced very high level precipitation in November 2008 with 23 rain days, which might have potential to cause landslides.



However, no severe landslide happening was reported during this soggy period. Correspondingly, (Samah, 2007) who conducted a case study of hillside problems in Bukit Antarabangsa, Selangor found that professionals involve in hillside developments are not alert in following the regulations and fail to take up good planning and design practice for hillside development. Design error is recognized as the most important risk for the success of a project that leads to cost overruns and delay (Andi and Minato, 2003; Kaliba et al., 2009; Sweis et al., 2008). Gue and Tan (2006) who investigate the hillside development projects in Malaysia also found that 60% of 49 landslide cases are due to design errors caused by inappropriate design check and 20% sources are by a combination of design and construction errors. Short of communication and poor coordination among project participants during the early stage also contribute to the many failure of hillside

development. For example, (Rasip, 2006) found that there is a lack of contact and cooperation between responsible technical departments in caring the development of hillsides.

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Table 1: Chronological slope failure events (JKR, 2009a, b)

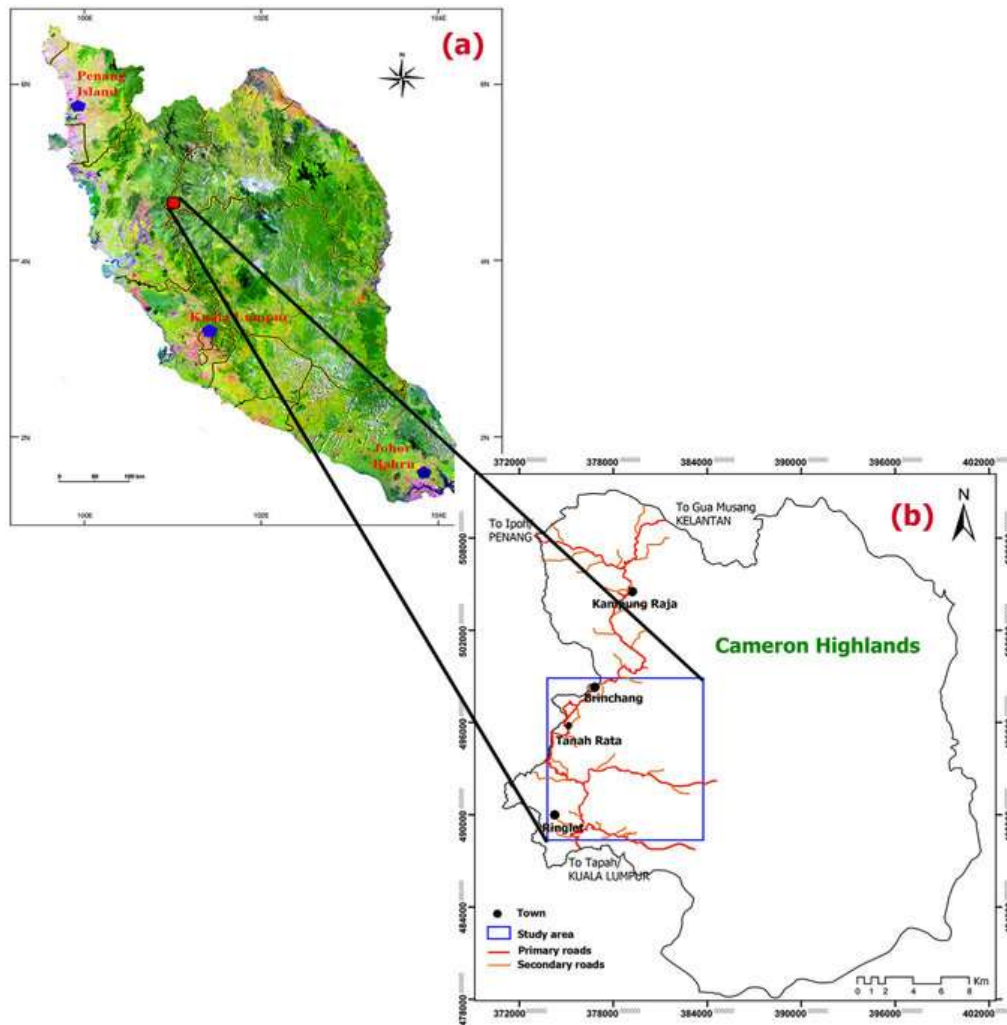
Dates	Landslide/slope failure events
14.12.1984	Slope failure at block 13
22.08.1985	Slope failure at the end of Jalan Wangsa 9 at block 12
14.10.1985	Signs of distress were appeared along Jalan Wangsa 9 with prominent cracks expanding approximately from lots 6280 to 6287 from block 13
08.11.1985	Block 13 and block 16 collapsed
06.12.2008	Landslide occurred at same location of block 13 and block 16 which toppled in 1985

Fault Producing Environments in Malaysian Mudslides

During the life cycle, of engineering systems from scheduling, designing, construction, installation, fabrication till maintenance, humans have to work sometimes as a planner, designer or a supervisor. Errors spawn through their actions are mentioned as design errors, construction errors or maintenance errors. In this way human uncertainties come into existence or simply speaking these are the results of human mistakes/ errors. On many occasions humans were the basis of devastating failures. Bea (2006) organized uncertainties into four categories with respect to major failures/accidents as:

- Natural variability
- Modelling
- Human and organizational
- Knowledge based





Morgenstern (1995) pointed out the catastrophic failure of Kwun Lung Lau landslide in Hong Kong. It is the input of human uncertainty. It is also reported by Ellingwood (1987) that mostly accidents or structural failures are not due to variation in the loads or resistances but in actual it's the outcome of the human errors. Design errors like abusing of the prescriptive method, construction errors pinpointing over excavation or wrong side excavation and in case of maintenance errors like clogged drainage system. These are the outstanding human errors pragmatic by Malaysian construction industry when rapid boost in slope failures takes place in different regions of Malaysia (Gue and Wong, 2008). The above mentioned scenario reflects the urgent need of Human Reliability Assessment (HRA) to control these diverse situations prevailing in Malaysian construction industry. Human reliability assessment relies on two different types of approaches for evaluation or estimation: one carrying databases and other totally relying on expert's opinion. The first category consists of those techniques which has already in hand generic error probabilities. These generic probabilities are than manipulate by the evaluator to extrapolate from the generic data to the particular scenario being considered. Manipulation is usually stood on assessor's judgment of situation governing Performance Shaping Factors (PSFs) or Error Producing Conditions (EPCs). Techniques lie in second category are not so structured, totally relying on personal communication and asking to estimate the probabilities or proportion of the situation related EPCs. The logic of assessing its proportion is to check whether how much the impact is creating and in which way it can be minimized or neutralized. Like some of the EPCs demands corrections in the prevailing codes and practices and some requires training sessions and workshops and scrutiny. The EPCs which are responsible for Malaysian slope failures in three distinct phases are given in Table 2. The list of EPCs has been prepared by following the second human reliability assessment approach of expert's opinion. Expert's opinion approach requires individuals having the knowledge and experience of the targeted tasks. A panel of six is at least required for estimation (Grozdanovic, 2005). The research follows Aggregated Individual Method and Consensus Group Method to work on the expert's opinion strategy. These methods are preferable as the opinions obtained through them are unbiased. Secondly author considers its less time consuming. Methods like Delphi and Nominal Groups entail more than one round and not let the expert to answer independently.

Causes

Behind the Highland Towers was a small stream of water known as East Creek. East Creek flowed into the site of the Highland Towers before the construction of Highland Towers, so a pipe system was built to divert the stream to bypass the Highland Towers.

In 1991, a new housing development project, known as Bukit Antarabangsa Development Project, commenced construction on the hilltop located behind the Highland Towers. The hill was cleared of trees and other land-covering plants, exposing the soil to land erosion that is the leading factor of causing landslides.

The water from the new construction site was diverted into the existing pipe system used to divert the flow of East Creek. This overloaded the pipe system and water, sand and silt from both East Creek and the construction site of Bukit Antarabangsa infiltrated the pipes. The pipes burst at several locations on the hill, and the surrounding soil (behind Block 1) had to absorb the excessive water. The monsoon rainfall in December 1993 further worsened the situation.

The water content in the soil became over-saturated to the extent that the soil had turned viscous, in effect becoming mud. By the end of November 1993, the hill slope had been saturated with water, and water was seen flowing down the hill slopes and the constructed retaining walls.

Shortly thereafter, a landslide took place and destroyed the constructed retaining walls. The landslide contained an estimated 100,000 square metres of mud – a mass equivalent to 200 Boeing 747 jets. The soil rammed onto the foundation of Block 1, incrementally pushing it forward. After of that constant pressure, the foundations of Block 1 snapped and in December 1993, residents began to see cracks forming and widening on the road around the Highland Towers, a forewarning of collapse. Unfortunately, there was no further investigation before Block 1 collapsed on 11 December 1993.

Impact on Duties of Building Professionals

A. The Architect

(i) No Defence That Engagement Was a Limited One, At the Very Least Must Ensure the Other Aspects of the Works by Others Was Done Competently

The Architect's defence that he was only retained to design and supervise the 3 apartment blocks, and denied that his scope extended to the drainage, earthworks and retaining walls.

This was rejected by the Court.

The Court held that the Architect must take into account the condition of the vicinity of the land upon which the building is built, as well as the land itself, must be evaluated when assessing the safety of the building.

[Also, as a matter of fact the Court found that the Architect was concerned with the vicinity as well as the building itself when he submitted the layout plan to the authorities as it included terracing and drainage of the hill slope behind Highland Towers. He must therefore ensure that this work, although carried out by others, is carried out in a competent and workmanlike manner]

(ii) No Difference in Standard of Care for Unqualified Practitioner

Even though the Architect was in reality only an Architectural draughtsman, the Court measured his conduct against the standard of a reasonably competent Architect, holding that if a man is unqualified but holds himself out to be possessing a skill, he would be judged by the standard of a reasonably competent qualified person.

(iii) No Excuse to Say That Employer Forced Non- Compliance with Laws

Finally, the Court appears to have emphatically rejected the excuse of the Architect that he could not stop his boss from doing anything (in the context of colluding with the employer and engineer in obtaining Certificates of Fitness for the three apartment blocks without fulfilling the conditions imposed by the Local Authority and not ensuring the terracing and retaining wall were properly designed, provided for and sufficient to withstand slope

failure even though he was aware it would affect the buildings he was in charge of) – the Court has clearly stated that when the law is broken, the Architect must report to the authorities – the architect must ensure that the law is followed even at the risk of being discharged.

B. The Engineer

The Engineer's defence that he was only retained to design and supervise the structural aspects of the 3 apartment blocks, two retaining walls within the Highland Towers compound and submit plans for the drainage and two and denied that his scope extended to the drainage, earthworks.

Court: Local councils cannot be held liable



Justice Abdul Hamid:
'Projects will stall. The local council may go bust'

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The court was unanimous in allowing the MPAJ's appeal to set aside the Court of Appeal's decision holding the MPAJ 15% responsible for the pre-collapse period.

As for the post-collapse liability, it dismissed with a 2-1 majority the cross-appeal by the 73 residents of Block Two and Three against the Court of Appeal's ruling that the MPAJ was not liable for losses suffered during the post-collapse period. Justice Shim gave a dissenting judgment.

Justice Abdul Hamid Mohamad said that if the local councils were made liable, it would open the floodgates to further claims for economic loss, and this would deplete the council's resources meant for the provision of basic services and infrastructure.

"Projects will stall. The local council may go bust. Even if it does not, is it fair, just and reasonable that taxpayers' money be utilised to pay the 'debts' of such people?"

"In my view, the answer is no," he said.

In overturning the trial judge's decision to allow the post-collapse claims, Justice Abdul Hamid said vandalism followed every disaster, natural or otherwise, in undeveloped, developing or developed countries.

"Recent events showed that even the most-powerful military and the best-equipped police force in the richest and most-developed country in the world were unable to prevent it," he said.

"In my view, the provision of basic necessities for the general public has priority over compensation for pure economic loss of some individuals, who are clearly better off than the majority of the residents in the local council area," he said.

He said a local council has an endless list of duties to perform for its residents and relied mainly on assessment rates and fees for licences.

Justice Arifin concurred with Justice Abdul Hamid's findings.

In his dissenting judgment on the post-collapse liability, Justice Shim said the MPAJ could not seek shelter in Section 95(2) of the Street, Drainage and Building Act because this was a case of negligence in failing to formulate and implement the master drainage plan so as to ensure the stability and safety of the adjacent Blocks Two and Three.

He said there was an assumption of responsibility by the MPAJ to do what it had promised.

"I do not think it would be in the public interest that a local authority such as the MPAJ should be allowed to disclaim liability for negligence committed beyond the expansive shelter of Section 95(2) or other relevant provisions of the Act nor would it be fair, just and reasonable to deprive the respondents of their rightful claims under the law," he said.

In 2000, High Court Judge James Foong ruled for the 73, and apportioned liability as follows: Arab-Malaysian 30%, Metrolux and MBF Property Services together 20%, Highland Properties 15%, MPAJ 15%, draughtsman Wong Ting San 10% and engineer Wong Yuen Kean 10%.

TERRIBLE DISASTER: The two collapsed blocks of the Highland Towers condominium is shown in this file photograph taken on Dec 11, 1993.

This was rejected by the Court

The Court held that the Engineer must take into account the condition of the vicinity of the land upon which the building is built, as well as the land itself, must be evaluated when assessing the safety of the building. He should have ensured the stability of the hill slope behind Highland Towers.

His duty was not discharged by a mere belief that the terracing of the hill slopes and the retaining walls built on them were carried out by an engineer or other consultant. He ought to have inquired as to

Whether this professional was qualified, and whether what he was doing affected the safety of the Tower Blocks. [Other Aspects of the Engineer's negligence – gross violation of his duty of care to the purchasers in the issue of a notification to the Authorities that the approved drainage was built when only 10% was built].

Conclusion

In spite of years of accumulated experience, the ability of the geotechnical occupation to express reliable calculations for slope failures/stability remains destitute. This is mainly due to the abundant sources of doubt that take over performance crags in geotechnical engineering. Essential natural unpredictability of soil possessions, lack of data, limits of models and above all human fears are some of the challenges that geotechnical engineers has to bear in routine. In this regard probabilistic techniques are most suitable option to quantify and incorporate uncertainty into slope analysis and design as compared to the traditional loom of safety factor. In actual this study conceded out that dependability theory can be used as a logical substitute and found it much more reliable.

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