Climate Change and Engineering Geological Challenges

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Editorial

For us, climate change is not a new concept. Weather patterns, vegetation, ground weathering, and hydrological elements are all changing over the world. Extreme heat in the summer, extreme cold in the winter, floods and droughts, as well as an increase in the frequency and intensity of hydro-meteorological disasters, all result in significant ecological and environmental damage. The loss of civilization has increased as the human population has grown and woodland and river plains have been encroached upon. Because of the increased hazards brought on by climate change, the World Meteorological Organization has determined that the world is approximately five times as risky and disaster-prone as it was in the 1970s. There were 3,496 natural catastrophes in the first decade of the twenty-first century, including floods, storms, droughts, and heat waves.

There were approximately five times as many disasters reported in the 1980s as there were in the 1970s. Floods and hurricanes, for example, are more dangerous than others [1]. Storms and flooding are also wreaking havoc on the economy. From 2000 to 2010, flooding and mega-storms were by far the most common causes of disaster. Flooding and storms were responsible for about 80% of the 3,496 disasters that occurred in the recent decade. Climate warming is causing sea levels to rise. Warming temperatures are increasing the devastating force of hurricanes, according to mounting research. Engineering geology and geo-mechanical elements of the earth play a vital role in mitigating the effects of climate change.

We use geological and geotechnical data from the area to create the best factor of safety for minimising the hazard prone zone. However, as the climate has changed dramatically in the last ten years, climatologists believe that rising sea levels will increase the frequency of hydro-meteorological disasters; impacted the ground by a sudden increase in pore water pressure, and water percolation along the joints in rock will cause landslides over a large area. Probably, the design considerations that we are considering today will not be appropriate in the following 10 years, and the design structure's lifespan will be reduced. Landslides, ground sinking, strong monsoon, and other effects of climate change are being observed in current infrastructure projects [2].

We must evaluate extreme weather conditions and advise preventative measures for projects in order to limit the impact of climate change on infrastructure projects. More study on climate change and engineering geological difficulties is also required, and it should be made publicly available for the benefit of the local population and administration.

Following is a summary of some of the probable effects of climate change on engineering geology practise. Areas of on-going study, potential consequences on the engineering geologist's more everyday work, and how the engineering geologist may help to climate change mitigation and adaptation have all been highlighted [3]. It is concluded that present planning guideline handles climate change more comprehensively than current engineering practise, and that engineering geologists have a lot of study opportunities in terms of prospective climate change implications. More precisely, it has been emphasised that present engineering practise mainly relies on empirical design methodologies, and it has been urged that this approach be reconsidered in light of climate change. Ground source heat pumps, carbon sequestration, the "reduce, reuse, and recycle" strategy to achieving sustainability, and Sustainable Urban Drainage Systems (SUDS) are among the mitigation strategies discussed [4].

Climate change evidence comes from a variety of sources. It is primarily fuelled by an increase in the global system's energy input. First, heat trapping occurs as a result of increased carbon dioxide, which reduces solar energy reflection; second, ozone layer depletion permits more incoming solar energy radiation; and third, higher solar energy radiation occurs as a result of reduced particle haze. Radioactive forcing, a numerical descriptor of the impacts on global warming (positive values) and cooling (negative values), is used to represent changes in these parameters (negative values). During the industrial era, the pace of rise in radioactive forcing was substantially faster than it had been in over 10,000 years [5]. Between 1995 and 2005, the radioactive forcing due to carbon dioxide alone increased by 20%. Even a cursory examination of the expected effects of climate change reveals a possible impact on both present and future engineering structures, such as tunnels, retaining structures, foundations, and basements. Groundwater levels, rainfall intensity, temperature ranges, and wind loadings will all demand a greater understanding of regional-scale projections by engineering geologists [6]. Also, a higher awareness of the extremes will be required; for example, groundwater levels are likely to fluctuate across a wider range in some regions, and seasonality is likely to become more extreme. For existing structures, consideration will need to be given to their inability to cope with increases in the frequency of extreme events, such as flooding caused by overloading of surface water drainage schemes, many of which have been stretched to their maximum capacity as a result of urban development. A third problem arises from the fact that higher energy levels during storm events have the ability to mobilise bigger sediment loads, further affecting drainage system capacity. It was not possible to completely develop all of the conceivable situations within the scope of this article; instead, a broad overview and indicator of the potential implications was offered, along with examples of more particular case studies from the literature.

Climate change's effects on the alluvial environment are already having an impact on engineering geological practise. Flooding is more common in alluvial soils and flood plains. Groundwater levels are also likely to become more seasonal. This could lead to faster weathering as a result of physical erosion during flooding, as well as the possibility of desiccation and enhanced wind erosion. Undercutting and slope instability may occur as a result of increased river discharge. Where foundations have been built using organic soils, such as in the estuary environment, the potential mobilisation of ground gases as a result of changes in groundwater levels may need to be considered. Warehouses and industrial structures, for example, are ubiquitous in the estuary environment, and many in the United Kingdom pre-date rules for the integration of gas remedial measures [7]. Although the techniques of ground investigation may not change significantly as a result of climate change, the focus of ground investigations may. Desk studies will be required to analyse the potential implications of climate change, including both regional climate change and potential ground reactions, in order to address this. Specific areas can be identified, such as the depth to groundwater, which is commonly impacted by climate change; it is possible that groundwater levels at some sites will differ from those expected, for example, due to extremely dry or wet periods, affecting the appropriate response zones for monitoring wells. Longer-term monitoring will be increasingly required to assess the possible impact of climate change, which would necessitate more stringent data preservation and processing procedures.

Carbon sequestration is the process of removing carbon dioxide from the atmosphere and storing it for a long time. Natural carbon sinks, such as forests and seas, are included in the phrase, but in the context of engineering geology, it refers to the collection and long-term storage of carbon dioxide before it is released into the atmosphere. Carbon sequestration is being explored in the short term to separate $CO2$ from other power plant emissions, followed by $CO2$ pumping underground. In the long run, this might be expanded to include $CO2$ capture from high-carbon industries like cement, ammonia, and iron production. Carbon dioxide sequestration is currently a major subject of engineering geological research. Understanding the physical properties of carbon dioxide is critical in determining if a site is suitable for carbon dioxide storage. The increase in carbon dioxide density in a depth range of 500 to 1000 m, depending on geothermal conditions, is particularly noteworthy. Areas of sufficient capacity (a function of porosity and thickness) and infectivity (permeability); presence of an extensive low permeability layer above the formation to prevent leakage (for example, shale, salt, and anhydrite beds); and a stable geological environment are all examples of suitable geological conditions. According to a study, natural and man-made caverns, underused porous and permeable reservoir rocks, exhausted oil and gas fields, and coal beds are the four key concepts for underground carbon dioxide storage sites. The British Geological Survey has been active in carbon dioxide underground sequestration, with an emphasis on the Sleipner West gas field, a sandstone reservoir in the Norwegian section of the North Sea, where one million tonnes of carbon dioxide are stored below per year. In some cases, subsurface CO2 storage poses a risk of fault reactivation, necessitating the measurement of in situ stresses and the assessment of fault stability. According to research, a number of important concerns must be addressed in order for this technology to expand to industrial plants and have a global influence on carbon dioxide emissions, including capture methods, evidence of safety and security, and public acceptability. Other research directions in carbon storage and capture include improving our understanding of carbon dioxide's physical properties and underground migration, assessing host rock/carbon dioxide interactions, especially in the context of carbonate stability, developing techniques for assessing and modelling site suitability, and monitoring carbon dioxide injection and monitoring. Aspects such as in situ stress conditions, geothermal gradients, receiving strata permeability, trap identification, and seismic stability assessments will all need to be investigated in the context of new sites, implying the potential for the development of new site investigation and monitoring techniques [8].

In the context of changes in stress conditions and weathering processes, this work has raised additional difficulties [9]. Climate change management, like other fields of research, necessitates more collaboration, both in terms of understanding processes and creating mitigation techniques. The lack of information available to the engineering geological community shows that knowledge transfer is required and it is hoped that this study has helped to raise awareness of the concerns and offer access to information. Modelling of climate change, including GCM and down-scaling methods, has received special attention, as it is critical for understanding the likely change scenarios for individual countries or regions, as well as for relating the likely engineering geological impacts of climate change [10]. Carbon sequestration, methane hydrates, and sustainable urban drainage systems are among the mitigation and adaptation strategies currently being researched Sustainable Drainage System (SUDS). The systematic method to analysing some of the expected implications of climate change on present practise has emphasised the opportunity for study in areas where empirical design is now used extensively.

References

1. Arnell, N.W., & Reynard, N.S. "The effects of climate change due to global warming on river flows in Great Britain." *J Hydrol* 183.3-4 (1996): 397-424.
2. Bacastow, R.B., et al. "Seasonal amplitude increase in atmospheric CO2 concentration at Mauna Loa, Hawaii, 1959-1982." *J Geophy Res Atmos* 90.D6 (1985): 10529-10540.
3. Barton, M. "Do coastal cities have a sustainable long-term future?." University of Southampton Institutional Repository (2007).
4. Dixon, N., et al. "Climate change impact forecasting for slopes (CLIFFS) in the built environment."*Engineering Geology for Tomorrow's Cities: Proceedings, 10th International Association of Engineering Geology Congress. Geolog Society, London*. 43. 2006.
5. Cooper, A.H., & Antony C.W. "Subsidence caused by gypsum dissolution at Ripon, North Yorkshire." *Quarterly J Eng Geol Hydrogeol* 32.4 (1999): 305-310.
6. Hulme, M. "Abrupt climate change: can society cope?." Philosophical Transactions of the Royal Society of London. Series A: *Mathemat Phys Eng Sci* 361.1810 (2003): 2001-2021.
7. Hulme, M., & Turnpenny, J. "Understanding and managing climate change: the UK experience." *Geograp J* 170.2 (2004): 105-115.
8. Sanner, B., et al. Thermal response test-experiences in Germany. Company Rep, UBeG, Zum Boden 6, D-35580 Wetzlar. 6p.
9. Sanner, B., et al. "Current status of ground source heat pumps and underground thermal energy storage in Europe." *Geothermics* 32.4-6 (2003): 579-588.
10. Zhang, K., et al. "Global warming and coastal erosion." *Clim Change* 64.1 (2004): 41-58.

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