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考虑超静孔隙水压力消散的管桩承载力时效性研究

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GROWTH OF PILE BEARING CAPACITY OVER TIME CONSIDERING THE DISSIPATING OF EXCESS PORE PRESSURE

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摘要 沉桩引起的超静孔隙水压力消散是产生管桩极限承载力时效性的主要因素之一。结合天津东疆保税港区物流加工区二期工程,利用有限元模拟分析沉桩后超孔压的消散规律及管桩的极限承载力随时间变化的规律,提出吹填土中管桩时效承载力公式供工程参考使用,并进行吹填土现场各测点沉桩过程及沉桩后孔隙水压力的监测,验证模拟结果的同时探讨超静孔隙水压力的分布及消散规律。模拟得到沉桩后桩底超孔压随时间消散, 20d后消散率达到97%; 管桩的时效承载力随时间增长,并与超孔压的消散有着明显的对应关系; 得到吹填土中管桩承载力的时效公式以供工程参考使用。现场孔压监测表明深度增加,超孔压增大; 离桩越近,超孔压越大; 土层渗透系数越小,超孔压消散越慢。施工对土体的有效影响范围为9~10倍桩径。

关键词: 吹填土 管桩 极限承载力 时效性 超静孔隙水压力

Abstract: The dissipating of excess pore pressure caused by pile sinking is one of the main factors result in time effect of ultimate bearing capacity of pile. This paper discusses the change rule of pile bearing capacity with time through the finite element simulation under the geological conditions of the pile foundation in the second phase project of the free port logistics processing zone in Dongjiang, Tianjin. It finds that the formula of pile bearing capacity about time effect in dredge fill can be used as reference for engineering use. It monitors the excess pore pressure at each observing point in order to verify the numerical simulation results. It discusses the change law of the distribution and dissipation of excess pore water pressure. Numerical simulation shows that the dissipation rate at the tip of pile can reach 97% 20d after pile sinking. The ultimate bearing capacity of pipe pile increases over time basically in accord with the dissipation of excess pore water pressure. It also introduces a formula of pile aging bearing capacity in dredge fill. Measured results show that the effective range of construction on dredger fill around the pile is 9-10 times the diameter of pile. The excess pore pressure increases with the depth increasing. The closer it from the pile, the greater the excess pore pressure is. The smaller the permeability coefficient of soil is,the more slowly the excess pore pressure dissipates.

Key words: Dredge fill Pipe pile Bearing capacity Time effect Excess pore water pressure

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[1] 冯会芳. 新近吹填淤泥形成超软土地基的加固处理方法[J].港工技术, 2011, 48 (5): 59~60.

Feng Huifang. Reinforcement method of ultra soft foundation formed by fresh dredger filled mud. Port Engineering Technology, 2011, 48 (5): 59~60.

[2] 叶国良, 郭述军,朱耀庭.超软土的工程性质分析[J].中国港湾建设, 2010, 170 (5): 1~9.

Ye Guoliang, Guo Shujun, Zhu Yaoting. Analysis on engineering property of ultra soft soil. China Harbour Engineering, 2010, 170 (5): 1~9.

[3] Wang Tiejun. On strengthening plan selection of cast-in-situ box girder subgrade in dredger fill soil layer with large-thickness. China Municipal Engineering, 2011, 4: 46~49.

[4] Jardine R J,Standing J R,Chow F C.Some observations of the effects of time on the capacity of piles driven in sand. Geotechnique, 2006, 56 (4): 227~244.

[5] Long J H,Kerrigan J A,Wysockey M H.Measured Time Effects for Axial Capacity of Driven Piling. Transportation Research Record 1663, 1999,Paper No.99-1183, 8~15.

[6] 张明义, 刘俊伟,于秀霞.饱和软黏土地基静压管桩承载力时间效应试验研究[J].岩土力学, 2009, 30 (10): 3005~3009.

Zhang Mingyi, Liu Junwei, Yu Xiuxia. Field test study of time effect on ultimate bearing capacity of jacked pile in soft clay. Rock and Soil Mechanics, 2009, 30 (10): 3005~3009.

[7] 胡中雄. 饱和软黏土中单桩承载力随时间的增长[J].岩土工程学报, 1985, 7 (3): 58~61.

Hu Zhongxiong. Growth of pile bearing capacity in saturated soft clay over time. Chinese Journal of Geotechnical Engineering, 1985, 7 (3): 58~61.

[8] Zhang Mingyi, Shi Wei, Wang Congge. Effect on the ultimate bearing capacity of static pressed pile. Chinese Journal of Rock Mechanics and Engineering, 2002, 21: 2601~2604.

[9] Chow F C,Jardine R J,Nauroy J F et al. Time-related increase in shaft capacities of driven piles in sand[J]. Geotechnique, 1977, 47 (2): 353~361.

[10] Doherty P,Gavin K. The shaft capacity of displacement piles in clay: A state of the art review[J]. Geotech Geol Eng, 2011, 29: 389~410.

[11] Bruey F,Meunier K,Neuroy J F.Behaviour of pile plug in sandy soils during and after driving.23rd Offshore Technology Conference, Houston, 1991, 145~154.

[12] Ng W K,Selamat M R,Choong K K.Soil/pile set-up effects on driven pile in malaysian soil. 2010, 14: 1~12.

[13] 姚笑青. 桩间土的再固结与桩承载力的时效[J].上海铁道大学学报(自然科学版), 1997, 18 (4): 91~94.

Yao Xiaoqing. The reconsolidation of the soil among piles and the time effect of pile bearing capacity. Journal of Shanghai Tiedao University (Natural Science), 1997, 18 (4): 91~94.

[14] Fei Kang, Zhang Jianwei. The Application of Abaqus in Geotechnical Engineering. Beijing: China Water Conservancy and Hydropower Press, 2010.

[15] 桩基工程手册编写委员会. 桩基工程手册[M].北京:中国建筑工业出版社, 1998.

[16] Pile Foundation Engineering Manuals Committee. Pile Foundation Engineering Manual. Beijing: China Architecture & Building Press, 1998.

[1] 孙凤慧. 东太湖堤线调整工程黏性吹填土特征[J]. 工程地质学报, 2011, 19(4): 483-486.

[2] 卢金岳. 预应力混凝土管桩挤土效应引起土体位移分析[J]. 工程地质学报, 2010, 18(S1): 148-153.

[3] 夏玉斌, 王永吉, 宋晶, 王清, 桑伟峰, 彭湘林. 真空预压法加固吹填土的沉降试验研究[J]. 工程地质学报, 2010, 18(S1): 306-310.

[4] 王珊珊, 李丽慧, 胡瑞林, 刘凯, 魏欣. 动力排水固结法加固吹填黏性土的模型试验研究[J]. 工程地质学报, 2010, 18(6): 906-912.

[5] 陈允进, 宋晶, 夏玉斌, 王清, 彭湘林. 真空预压法加固吹填土的孔隙水压力试验研究[J]. 工程地质学报, 2010, 18(5): 703-708.

[6] 李丰, 吴群昌, 姜规模, 蔡金选, 曹瑞雨. 灌注桩后注浆技术在工程中的应用效果检测[J]. 工程地质学报, 2010, (): 331-334.

[7] 李德胜 李大勇. 盾构机下穿桩基施工对单桩承载力影响的数值研究[J]. 工程地质学报, 2009, 17(2): 284-288.

[8] 姜规模, 吴群昌, 蔡金选, 张思玉, 韦显呈. 西安市某工程钢筋混凝土钻孔灌注桩试桩试验研究[J]. 工程地质学报, 2008, (S1): 329-333.

[9] 熊孝波, 桂国庆, 刘献江, 许建聪. 基于ANFIS的全夯式扩底灌注桩极限承载力预测研究[J]. 工程地质学报, 2008, (S1): 340-344.

[10] 郭连盛, 高彦斌. 两种桩型受荷性能对比现场试验研究[J]. 工程地质学报, 2008, (S1): 391-394.

[11] 张雷, 陈时栩, 仇建华, 张鹏. 大直径钻孔灌注桩桩身倾斜数值模拟分析研究[J]. 工程地质学报, 2008, (S1): 407-410.

[12] 吕艳平, 陈福全, 雷金山. 不排水双层粘性土地基极限承载力的数值分析[J]. 工程地质学报, 2007, 15(6): 766-771.

[13] 韩选江, 朱进军, 王黎明, 朱允伟, 赵翔. 真空动力固结在高饱和吹填软土地基上的夯击能传播效应研究[J]. 工程地质学报, 2006, (S1): 355-359.

[14] 吴春勇, 王清. 软土地基中沉桩引起的超静孔隙水压力研究[J]. 工程地质学报, 2006, (S1): 390-393.

[15] 刘莹, 王清. 水泥与生石灰处理吹填土对比试验研究[J]. 工程地质学报, 2006, 14(3): 424-429.

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