GALAXY INTERNATIONAL INTERDISCIPLINARY RESEARCH JOURNAL (GIIRJ)
ISSN (E): 2347-6915
Vol. 10, Issue 3, Mar. (2022)

ANALYSIS OF CASES OF DEFORMATION OF THE CYLINDRICAL CORE OF SKYSCRAPERS

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ABSTRACT

This article is devoted to the analysis of cases of deformation of the cylindrical core of skyscrapers. The author, relying on the data of the construction industry, analyzed the problem on the basis of the available scientific literature and studied the existing specific aspects of the analysis of cases of deformation of the cylindrical core of skyscrapers.

Keywords: monitoring, reinforced concrete, experimental data, stress-strain state, calculation model, high-rise buildings.

INTRODUCTION

Work on a large-scale experimental study of the stress-strain state (SSS) of the supporting structures of high-rise buildings began to be carried out in the late 1990s - early 2000s, which is associated with the development of high-rise construction around the world (USA, EU countries, Russia, UAE, Japan , China, Singapore, etc.). Abroad, these studies are based on the experience of instrumental observations of infrastructure objects: bridges, tunnels, dams, etc., the methodology of which has been worked out by now and large amounts of data have been obtained [1, 2]. Research dedicated to the monitoring of large-span bridges allows solving a number of important tasks, the main of which are [3]:

checking the design assumptions and parameters of the design models to improve the design solutions for future structures, as well as amending the regulatory documentation; detection of loadings not provided for by the project and reactions from the side of the structure in the early stages of its operation to prevent emergency situations; collection of data on the state of structures in real time to assess the safety of structures immediately after emergencies (natural disasters, etc.); collection of data on the state of structures for planning visual inspections, inspections, scheduled repairs; accumulation of arrays of experimental data for research in the field of resistance of structures to wind and seismic effects, design of new types of structures and the use of modern materials.

MAIN PART

Currently, these tasks are also becoming relevant for high-rise buildings, but much less research has been carried out in this area. There are known works by R. Katzenbach and others on instrumental monitoring of bases and foundations of high-rise buildings located in difficult

geological conditions (Frankfurt am Main, Germany). The main objective of these studies was to confirm the design assumptions used in the design of combined slab-pile foundations [4, 5].
Large-scale studies of the stress-strain state of the load-bearing structures of the above-ground part of high-rise buildings began to be carried out in the last decade. One of the most significant works is the pilot project for monitoring high-rise buildings in Singapore, which started in 2001 [6], which has already yielded a number of promising results.
It is important to note that Russia is one of the leaders in this area. Integrated monitoring systems have been introduced at construction sites in Moscow since 2004 [7]. A significant role in this was played by the requirement to monitor the construction and operation of high-rise buildings, enshrined in Russian legislation and regulations (No. 384-FZ, MGSN 4.19-2005, etc.). This article presents only a small part of the results obtained during the monitoring of high-rise buildings, which is carried out in Moscow by the leading research and design organization for high-rise construction JSC "TsNIIEP residential and public buildings (TsNIIEP dwelling)".
One of the most important stages in the study of SSS in high-rise buildings is the comparison of calculated and experimental data [8], which includes solving the following problems:
Adequate modeling of the soil base;
Accounting for changes in building parameters during construction and commissioning (changes in material properties over time and under load, staging of load application, transformation of the design scheme); taking into account temperature factors.

RESULTS AND DISCUSSIONS

The issues of modeling the soil foundation of high-rise buildings are considered in detail in [9–11]. Accounting for temperature factors is carried out in the process of processing the data of the monitoring system by introducing appropriate amendments. The possibility of taking into account the staging of the application of loads and the transformation of the design scheme in the process of erecting a building depends on the design complex used. This function is implemented in the calculation complexes used in Russia [12].
It is proposed to take into account the change in the deformation characteristics of reinforced concrete over time and under load in the process of recalculating the stresses obtained from the elastic calculation of the computer model of the building into the deformation of the structure in each specific period of time. In this case, a simplified method is used to determine the plastic deformations of concrete [13].
The building is equipped with a modern integrated instrumental monitoring system for SSS of load-bearing structures, which includes sensors of relative deformations in the foundation slab and in the walls of the 1st floor. This system has already made it possible to obtain time-detailed and statistically significant data arrays on the state of structures [14].
Based on the forces obtained from the calculation, the relative deformations in the supporting structures were calculated. In this case, the deformations of reinforced concrete structures were determined as the sum of elastic deformations εe, creep deformations εpl and free shrinkage deformations εs. The calculation of creep strains was carried out according to the superposition principle, which means that the total creep strain under alternating stress can be found as the sum of the creep strains caused by the corresponding stress increments: n

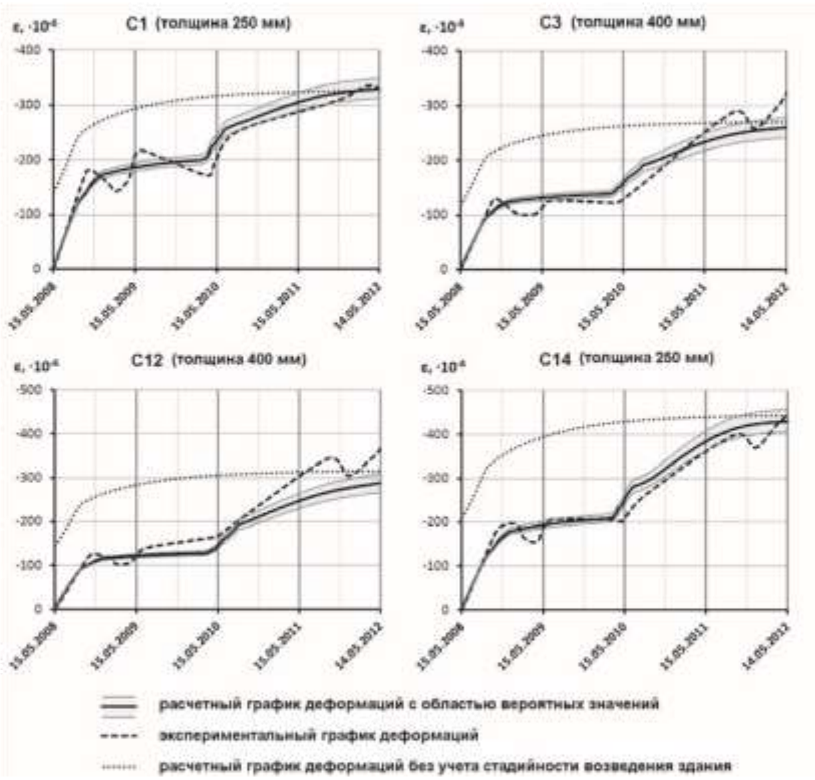
$\varepsilon = \varepsilon pl \sum_{pl\ i}, (\Delta\sigma - i, t\ ti),$

i=1

where $\Delta\sigma i$ is the stress increment from the i-th stage of loading; n is the estimated number of loading stages; ti is the date of application of the load of the i-th stage of loading; t is the date for which the creep strains are calculated.

Rice. 2. Schedule for the construction of a residential building, st. Dybenko, 38

This technique made it possible to build calculated graphs of changes in relative deformations in load-bearing structures during the construction and operation of the building, which reflect the predicted change in the stress-strain state of structural elements and the operation of the building as a whole. On fig. Figure 3 compares the calculated and experimental data for the walls of the 1st floor of various thicknesses (250 and 400 mm) for 4 years (from 2008 to 2012), shows the possible range of deformation changes according to the calculation, reflecting the probabilistic nature of the loads applied to the building model.



Rice. 3. Comparison of calculated and experimental graphs of relative deformations in the walls of the 1st floor during the construction and operation of the building

The calculated graphs obtained taking into account all of the above factors that affect the formation and change of the stress-strain state of the supporting structures of a high-rise building are close to the graphs built on the basis of the monitoring system data, both qualitatively and quantitatively. This allows you to make an informed decision about the compliance of the building work with the project.

REFERENCES

1. Отклонения экспериментальных графиков от расчетных свидетельствуют о наличии неучитываемых факторов, оказывающих влияние на НДС несущих конструкций высотного здания, в первую очередь, перераспределения усилий в статически неопределимых системах и реологических свойств железобетона.
2. Сопоставление расчетных и экспериментальных данных может быть использовано для оптимизации расчетных моделей.
3. При анализе данных системы мониторинга выявленные отклонения нужно принимать во внимание, чтобы не сделать преждевременных выводов о необходимости принятия аварийных мер.

ИСПОЛЬЗОВАННАЯ ЛИТЕРАТУРА

1. Casciati F. An overview of structural health monitoring expertise within the European Union. In: Wu Z.S., Abe M. Structural health monitoring and intelligent infrastructure — Proceedings of the 1st International Conference on Structural Health Monitoring and Intelligent Infrastructure. Lisse, the Netherlands, Balkema. 2003, vol. 1, pp. 31—37.
2. Glisic B., Inaudi D. Fibre Optic Methods for Structural Health Monitoring. John Wiley & Sons, Inc., 2007, 276 p.
3. Ko J.M., Ni Y.Q. Technology developments in structural health monitoring of largescale bridges. Engineering Structures. Elsevier, 2005, vol. 27, no. 12, pp. 1715—1725.
4. Katzenbach R, Hoffmann H., Vogler M., Moormann C. Costoptimized Foundation Systems of High-Rise Structures, based on the Results of Actual Geotechnical Research. International Conference on Trends in Tall Buildings, September 5—7, 2001. Frankfurt on Main, pp. 421—443.
5. Schmitt A., Turek J., Katzenbach R. Application of geotechnical measurements for foundations of high rise strucutres. 2nd World Engineering Congress (WEC), 22–25 July 2002. Sarawak, Malaysia, pp. 40—46.
6. Glisic B., Inaudi D., Lau J.M., Fong C.C. Ten-year Monitoring of high-rise building columns using long-gauge fiber optic sensors. Smart Materials and Structures, 2013, vol. 22, no. 5, paper 055030.
7. Мониторинг в процессе строительства напряженно-деформированного состояния несущих конструкций и грунтов основания высотных зданий в Москве / А.Б. Вознюк, Н.К. Капустян, В.К. Таракановский, А.Н. Климов // Будівельні конструкції. 2010. Вып. 73. С. 461—467.

8. Алмазов В.О., Климов А.Н. Актуальные вопросы мониторинга зданий и сооружений // Сб. докладов традиционной науч.-тех. конф. профессорско-преподавательского состава Института строительства и архитектуры. М. : МГСУ. 2010. С. 169—174.
9. Тер-Мартиросян З.Г., Теличенко В.И., Королев М.В. Проблемы механики грунтов, оснований и фундаментов при строительстве многофункциональных высотных зданий и комплексов // Вестник МГСУ. 2006. № 1. С. 18—27.
10. Крыжановский А.Л., Рубцов О.И. Вопросы надежности проектного решения фундаментных плит высотных зданий // Вестник МГСУ. 2006. № 1. С. 191—198.
11. Безволев С.Г. Проектирование и расчеты оснований и фундаментов высотных зданий в сложных инженерно-геологических условиях // Развитие городов и геотехническое строительство. 2007. № 11. С. 98—118.
12. Кабанцев О.В., Карлин А.В. Расчет несущих конструкций зданий с учетом истории возведения и поэтапного изменения основных параметров расчетной модели // Промышленное и гражданское строительство. 2012. № 7. С. 33—35.
13. Рекомендации по учету ползучести и усадки бетона при расчете бетонных и железобетонных конструкций. М. : Стройиздат, 1988. 121 с.
14. Климов А.Н. Методика обработки данных системы мониторинга высотного здания // Промышленное и гражданское строительство. 2012. № 12. С. 42—43.