ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-5206, Impact Factor: 12,23
**American Academic publishers, volume 05, issue 06,2025**

Journal: https://www.academicpublishers.org/journals/index.php/ijai

**UDC: 528**

# DESIGNING A SPATIAL GEODETIC NETWORK FOR THE CONSTRUCTION OF A MULTI-STOREY RESIDENTIAL BUILDING

***Tagaeva Dilafruz Usmonovna***
*docent, Associate Professor of the Department of Engineering Geomatics*
*, Tashkent University of Architecture and Civil Engineering*
*Tashkent, Uzbekistan, E-mail: taqi_gvak_konferentsiya@mail.ru*
***Kenjayev Ulugbek Abdulakimovich,***
*Senior Lecturer at the Department of Engineering Geomatic,*
*Tashkent University of Architecture and Civil Engineering*
*Tashkent, Uzbekistan*
***Ravshanov Bekzod Shukhratovich,***
*Student of the Department of Engineering Geomatics,*
*Tashkent University of Architecture and Civil Engineering*
*Tashkent, Uzbekistan, E-mail:bekzodravshanov@mail.ru*

**Annotation:** This article outlines the main stages of designing a spatial geodetic network during the construction of a multi-storey residential building, methodological approaches, and the accuracy requirements for geodetic measurements. It presents geodetic measurement methods, software tools, and key aspects of the design process, illustrated through practical examples.
**Keywords:** spatial geodetic network, electronic total station, coordinates, monitoring of the spatial geodetic network.

**Аннотация:** В данной статье освещены основные этапы проектирования пространственной геодезической сети при строительстве многоэтажного жилого здания, методологические подходы, а также требования к точности геодезических измерений. В статье представлены методы геодезических измерений, программное обеспечение и важные аспекты проектирования на основе практических примеров.
**Ключевые слова:** пространственной геодезической сеть, электронный тахеометр, координаты, мониторинг пространственной геодезическое сети.

**Introduction:** In the construction of multi-storey buildings, accuracy and reliability are among the main requirements in the field of geodesy. Proper design and placement of spatial geodetic networks at all stages of the construction process is one of the most important tasks of engineering geodesy. This article addresses one of the practical issues of urban geodesy-the stages, methodology, and accuracy requirements for designing a spatial geodetic network for multi-storey buildings.

**Main part:** The purpose and significance of a spatial geodetic network lie in its role as the core of the engineering-geodetic system. Especially in complex structures such as multi-storey residential buildings, it ensures the accurate placement of all structural elements. Through these networks, the design coordinate system is linked to the natural earth surface, ensuring height, direction, and geometric symmetry accuracy.

Main tasks of the network:

- Transferring the design to the site;

ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-5206, Impact Factor: 12,23
**American Academic publishers, volume 05, issue 06,2025**

Journal: https://www.academicpublishers.org/journals/index.php/ijai

- As-built survey;
- Determining and preserving construction axes;
- Transferring and controlling elevation marks;
- Providing a reliable basis for subsequent geodetic work.

Design Stages. Geodetic analysis of the area: In the first stage, available topographic and geodetic data on the construction site are collected. Terrain relief, existing geodetic points, and aboveground and underground communications are considered. At this stage, aerial photographs can be taken using UAVs (drones), or terrain can be modeled using LIDAR technology.

Selection of base geodetic point system: The network must be optimal and stable. It should meet the following criteria: Points must have indivisibility; each point must be connected to at least 3–4 others; their coordinates must be determined with high accuracy.

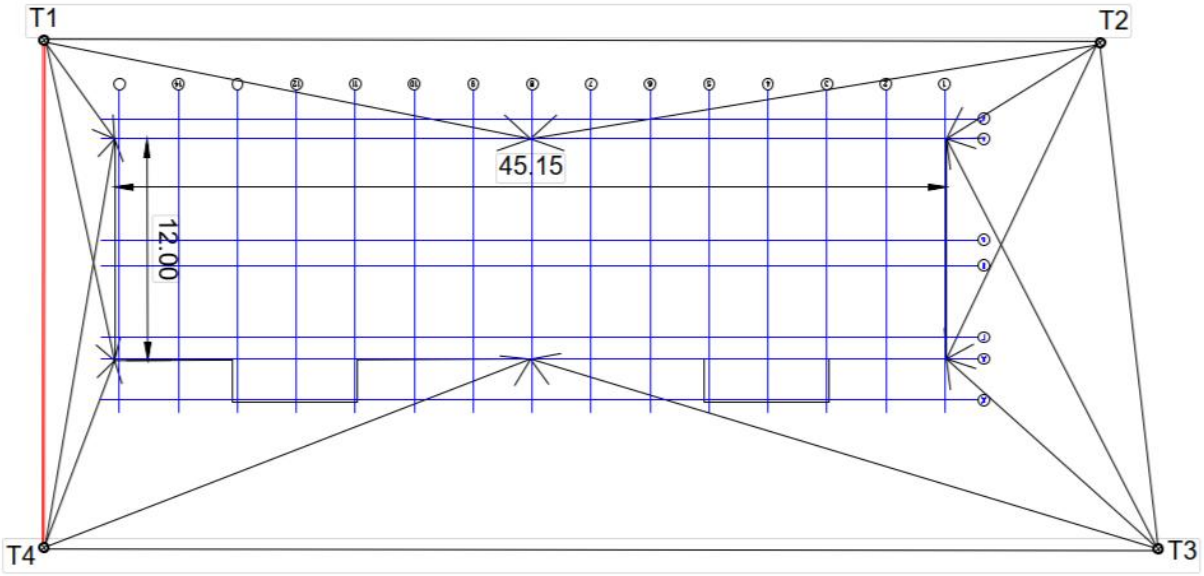


Fig. 1. Scheme for observing the deviation of the building

Points are determined using GPS/GNSS stations (in static or semi-kinematic mode), and sometimes using optical methods such as electronic total stations.

Calculations and accuracy analysis. Accuracy indicators are a key criterion in network design. The following elements are calculated: Coordinate dispersion (σx, σy, σz); Covariance matrix; Redundancy; Reliability coefficient (α) and accuracy limits.

Accuracy requirements for multi-storey buildings:

- Horizontal positioning: ±5 mm;
- Elevation mark: ±3 mm;
- Angular accuracy: not more than 5″ (seconds).

Example – “Xon Saroy Zo‘rsan” Residential Complex (Tashkent, 2025) A spatial geodetic network was established using high standards. The results confirmed that correct design directly affects construction quality.

ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-5206, Impact Factor: 12,23

**American Academic publishers, volume 05, issue 06,2025**

Journal: https://www.academicpublishers.org/journals/index.php/ijai

| Floor level | Design Coordinates | | | Actual Coordinates | | | Difference in X-axis (mm) | Difference in Y-axis (mm) | Difference in H-axis (mm) |
|---|---|---|---|---|---|---|---|---|---|
| | X | Y | H | X | Y | H | $X_L$-$X_A$ | $Y_L$-$Y_A$ | $H_L$-$H_A$ |
| 1 st Floor | 917,584 | 707,154 | 484,178 | 917,585 | 707,153 | 484,18 | -1 | 1 | -2 |
| 2 nd Floor | 917,584 | 707,154 | 487,678 | 917,583 | 707,152 | 487,677 | 1 | 2 | 1 |

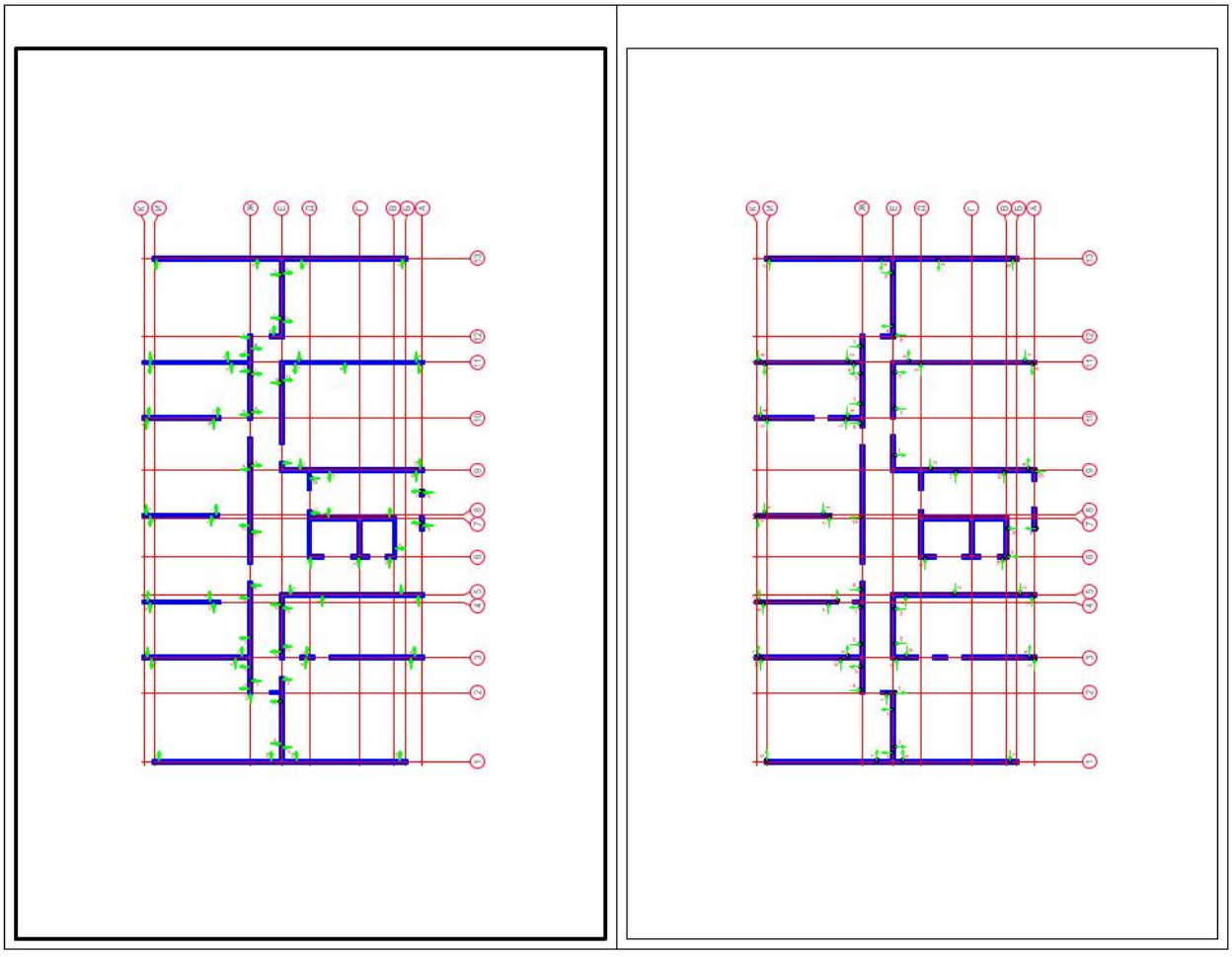

Fig. 2. Execution scheme of the building (by floors)

Final documentation. In the final stage, based on the location, coordinates, and connection schemes of the points, the following working documents are prepared: Geodetic network diagram; Detailed information on each point; Measurement protocols; Comparative analysis tables.

ISSN: 2692-5206, Impact Factor: 12,23
**American Academic publishers, volume 05, issue 06,2025**
Journal: https://www.academicpublishers.org/journals/index.php/ijai

Software and technologies. Modern spatial geodetic networks are designed using software such as AutoCAD Civil 3D, CREDO DAT, Trimble Business Center, and Leica Geo Office. They offer advantages like: 3D visual modeling; Automated calculations; Fast processing of GPS/GNSS data; Export of reports.
Integration with BIM (Building Information Modeling) technology is also possible, ensuring spatial accuracy throughout the project lifecycle.
Monitoring During Construction. During construction, network points may shift, deform, or be lost. Therefore, the following tasks are carried out: Re-measurements (monthly or periodically); Installation of monitoring stations (operating 24/7); Comparison of results with original project values. These monitoring processes are especially important in seismically active regions.
**Conclusion.** Designing and organizing a spatial geodetic network for the construction of a multi-storey residential building is a decisive factor in ensuring geometric accuracy, safety, and economic efficiency. The methodological approaches presented in the article show that modern GNSS technologies and digital tools reduce human influence, time, and costs, while providing fast and accurate results. Ongoing monitoring and inspections help maintain the stability of the network. Therefore, designing a spatial geodetic network should be considered a separate scientific and practical phase in any major construction project.

**Literature:**

1. Подшивалов В.П., Нестеренок М.С., Мкрытчян В.В. Геодезическое обеспечение строительства. Учебно-методическое пособие Минск БНТУ. 2013 г.
2. Подшивалов В.П., Нестеренок В.Ф., Нестеренок М.С., Позняк А.С. Геодезия в строительстве. Учебник. Минск РИПО. 2019 г.
3. ME'MORCHILIK va QURILISH MUAMMOLARI (ilmiy-texnik jurnal, part-2 "Ko'p qavatli baland binolar qurilishida geodezik ishlar aniqligini tadqiq qilish" 125-page.
4. Vaníček, P., & Krakiwsky, E. J. (1986). Geodesy: The Concepts. North-Holland.
5. BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers (4th ed).