Investigation of objects of forensic construction and technical expertise using drones

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Abstract. The article deals with the problems of using special methods of forensic construction-technical expertise. The classification of methods and means on various grounds, in particular, on the nature of the impact on objects and on the principle of operation is proposed, the specifics of their use in full-scale and laboratory studies are analysed. Special attention is paid to the use of unmanned aerial vehicles for inspection of construction objects and land plots functionally related to them. In some cases, objects may be difficult to access or dangerous for the expert. Thanks to drones, experts can quickly get an overview of the condition of the site and then examine the areas of interest in more detail. In addition, the use of quadrocopters contributes to the safety of conducting investigations. In general, the use of quadrocopters in forensic construction and technical expertise is a promising and useful tool. It is shown that timely replenishment of the construction expert's instrumental arsenal with modern techniques and methods of research based on the latest achievements of science and technology is the key to sustainable development of forensic construction and technical expertise as one of the most demanded by Russian legal proceedings areas of expert activity.

Keywords: forensic construction and technical expertise, forensic examination methods, forensic examination tools, field research, quadrocopter, drone, unmanned aerial vehicle

1 Introduction

The forensic expert's conclusion must meet the requirements of completeness, reliability, objectivity and comprehensiveness in accordance with the current legislation regulating forensic expert activity in the Russian Federation.

The problem of ensuring compliance of the forensic construction expert's report with the above requirements is mainly determined by the fact that the main objects of forensic construction expertise of buildings and structures are usually partially hidden from the researcher, and the most significant fragments of the construction object are inaccessible for direct visual perception.

The use of technical means allows the expert to "advance" much further in the search for objective data relevant to the subject of the study [1-6].

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2 Materials and Methods

Specialised methods

Special methods are understood as methods, the scope of application of which is limited to one or more sciences or branches of applied activity. Special methods of forensic building and technical expertise can be classified on two bases: by the nature of the impact on objects and by the place of research.

On the first basis, methods are divided into destructive and non-destructive.

When using non-destructive methods, products, structures, buildings and structures remain suitable for operation. Such methods include: radiation, X-ray, gamma-method, acoustic, magnetic, ultrasonic defectoscopy and thickness measurement, method of penetrating substances (capillary, leak detection and similar methods).

When destructive methods are used, the integrity and structure of samples and products are irreversibly damaged. These methods include, in particular, physical-mechanical and physical-chemical methods of examination of samples of materials extracted from the structures of buildings and structures.

According to the place of forensic research methods are divided into field (e.g. geodetic measurements, geometric measurements of construction objects) and laboratory (chamber).

The use of in-situ methods in practice is associated with procedural and organisational problems, in particular, in the distribution of responsibilities for the opening of soils (pits) and finishing structures of walls and floors to determine their design features.

To date, providing experts with the disputed construction object for its comprehensive study is the responsibility of the party to the case, which is the owner of the investigated object or carries out its economic use.

The requirement to provide the object in a form suitable for examination follows from the general principle of civil procedural law, according to which the burden of proof rests on the disputing parties. Part 1 and Part 3 of Article 65 of the Arbitration Procedural Code of the Russian Federation "Duty of Proof" disclose this provision in sufficient detail: "Each person participating in the case shall prove the circumstances to which it refers as the basis of its claims and objections"; "Each person participating in the case shall disclose the evidence to which it refers as the basis of its claims and objections to other persons participating in the case before the court session or within the time limit set by the court, if the court has not received the evidence from the other persons participating in the case."

Article 16 of Federal Law No. 73-FZ of 31 May 2001 "On State Forensic Expert Activity in the Russian Federation" obliges the expert to "...draw up a motivated written report on the impossibility to give a conclusion and send this report to the body or person who appointed the forensic expert examination, if ... research objects and case materials are unsuitable or insufficient for conducting research and giving a conclusion and the expert is refused to supplement them ...". Soil stripping is not a stage of expert examination, as it is only a preparatory work to bring the object of research into the necessary condition. The current legislation does not obligate the expert to bring the objects of research into a form suitable for research.

Taking into account the disposition of Article 65 of the Arbitration Procedural Code of the Russian Federation, it can be concluded that the obligation to provide the disputed construction object in a condition prepared for forensic examination is a logical continuation of the desire of the parties to the case to position themselves in the adversarial process as active participants, defending their legitimate interests. Thus, the indication in the Arbitration Procedural Code of the Russian Federation on the obligation to perform certain actions by the plaintiff or the defendant is conditional and presupposes active participation in the process of proving the case: if a party takes a passive position in the judicial process, it does not have an obligation (obligation to open the soil). At the same time, based on the established practice, the court considers and makes decisions by examining and evaluating the evidence provided primarily by the active party, as well as other evidence.
"Unmobility" of the main objects of forensic construction and technical expertise, their special status (property), large size and complexity cause significant time expenditures for in-situ research conducted by an expert builder in the presence of the parties to the case or their representatives.

**Use of unmanned aerial vehicles**

In-situ research can be conducted both directly at the research site and indirectly (non-contact), for example, using ground-controlled drones - unmanned aerial vehicles that differ in degree of autonomy, design, purpose and other parameters [7].

A quadrocopter is an unmanned aerial vehicle with four propellers, usually launched by remote control. As a rule, it is equipped with a mini-camera, which allows in-flight photography and video recording and obtaining high-quality images of land plots, building complexes, industrial areas, households and individual construction objects from points that are usually inaccessible to an expert (e.g. over neighbouring territories, households, buildings, water bodies, pits, trees and bushes) [8].

Professional quadrocopters of 350 class and above are used in forensic construction and technical expertise (the class of quadrocopter in digital terms (e.g. 350, 450) determines the distance (in mm) diagonally from one motor of this device to another), i.e. "heavy" drones with extended functionality, equipped with reliable security and wireless communication systems, high-quality cameras. Their system of stabilisation and positioning in space ensures a stable horizontal position when hovering so that the horizontal image of the terrain reflects the slope of the terrain.

The use of quadrocopters in field surveys of construction sites and land plots allows:
- to conduct reconnaissance of the investigated territory, complexes of buildings or separate long and complex objects in terms of construction;
- significantly reduce the labour intensity and time costs of in-situ surveys;
- provide a spatially free (without the operator being tied to the ground) point of survey of objects;
- to carry out high quality situational aerial survey of land plots, building complexes, production areas, households and individual construction objects from a certain height;
- to carry out high quality general, overview, orientation and nodal survey of the investigated objects - both externally and internally;
- ensure safe inspection of land plots, construction objects, their structural elements and units in hard-to-reach and emergency locations without using technical means (scaffolding, car lifts, swimming vehicles, all-terrain vehicles, etc.), services of industrial climbers, without endangering the life and health of experts and without spending additional material resources;
- to draw an approximate outline of land plots, building complexes, industrial territories, houses for comparative analysis with submitted or prepared schemes made on the basis of geodetic works, in order to avoid possible errors;
- to survey the spatial position of complex complexes of buildings and structures formed as a result of dense construction and piles, with combined use of different building materials, often having great physical wear and tear.

Along with the above advantages of using drones in forensic practice, there are some organisational problems. The operation of drones directly depends on weather conditions, which leads to adjustments in the production plans of forensic experts. The use of drones requires a special permit, and its absence may become an obstacle to the expert's work. The procedure for the use of the airspace of the Russian Federation, including the use of unmanned aircraft, is established by the Federal Rules for the Use of Airspace of the Russian Federation, approved by Resolution of the Government of the Russian Federation No. 138 of 11.03.2010. For example, when one of the parties to a case represents the authority issuing such permits or the object of expertise is located near special areas "closed" to aerial view (military facilities, prisons, government communication facilities, etc.). In this case, a drone that violated the airspace of a restricted facility may be neutralised or shot down by electronic warfare, which will cause material damage to the forensic institution (organisation) [9].
3 Results
In compliance with the current rules and taking into account weather conditions, the use of unmanned aerial vehicles is very promising in the practice of forensic construction and technical expertise. Their use in combination with improving "ground" technical means and equipment (including laboratory equipment) will make it possible to conduct forensic construction-technical investigations at a high professional level, fully meeting the requirements of modern legal proceedings.

The introduction of quadrocopters (drones) into the practice of forensic construction and technical expertise seems to be an important step in the development of this area of forensic activity. This will improve the process of conducting inspections of objects, reduce time and improve the availability of information about them, as well as increase the safety of work [10-14].

Inspection of the object is an important stage of the forensic construction and technical expertise. Therefore, after the completion of the inspection, it is necessary to carefully review the working records and, if necessary, make additions and clarifications. It is also important to check the completeness of the assembled tools, equipment, personal protective equipment and aids. However, conducting site inspections can involve a number of organisational and technical challenges. For example, some sites may be difficult or dangerous to inspect. In such cases, the use of quadrocopters can greatly simplify the inspection process by providing detailed information on the condition of the site from a height and from different angles. This is particularly useful when inspecting high-rise or complex structures. In addition, the use of quadrocopters can reduce the time required to conduct and process inspections. Traditional inspection methods can be time-consuming, especially when working on large structures or in hard-to-reach areas. With the help of drones, experts can quickly get an overview of the condition of a site and then examine areas of interest in more detail.

Conclusions
The safety of research is also an important aspect of forensic construction expertise. The use of quadrocopters reduces the risk for experts, as they can inspect objects from a safe distance. This is particularly relevant when inspecting unstable structures. In general, the introduction of quadrocopters into the practice of forensic construction expertise provides new opportunities and advantages. It allows construction experts to successfully and effectively solve their tasks, improving the quality and accessibility of the conducted inspections, reducing the time and increasing the safety of forensic construction and technical investigations.

Forensic construction and technical expertise will meet the requirements of modern legal proceedings only if its instrumental arsenal is replenished in a timely manner with techniques and research methods (including special ones) based on the latest achievements of science and technology.

References


