

1.14.27. FEATURES OF EXAMINATION AND NONDESTRUCTIVE TESTING OF METAL BUILDING STRUCTURES

Eremin K.I., Matveyushkin S.A., LLC “WELD”, Magnitogorsk, Russia

Provision of safety operation of buildings and constructions is an actual task resolved by the set of measures at all stages from project designing to its liquidation. Accident-free operation of buildings and constructions is performed on the basis of applicable normative and legal documents establishing requirements directly to structures of buildings and constructions, supervision over their technical state, technological processes carried out within buildings and structures, operational and servicing personnel of industrial enterprises and operational services of projects of civil destination.

Analysis of reasons of accident destruction of buildings and construction structures carried out on the basis of data published in mass-media and by the results of accident examination performed by the LLC “WELD” specialists studying makes it possible to mark out the following main reasons:

- violation of operation rules;
- defects at the construction stage and deviations from designs;
- violations of building practice during construction, reconstruction and repairs;
- low quality of building structures manufacturing.

Basing on the presented data, it is clear that problems of trustworthy evaluation of the structure state and revealing of potentially dangerous situations, which can lead to the accident destruction of buildings become of foremost importance. Correspondingly, mistake of an expert organization during project evaluation “contributes” significantly accident destruction of buildings. Mistakes of expert organizations can be related not only with low qualification of individual specialists, but with the absence of required non-destructive testing and diagnostic instruments in linkage to building structures and conditions of their operation as well.

Since the list of building structures is quite extensive and diverse, it is proposed to narrow the field of claims within the frames of this paper to the metal structures for buildings of industrial destination.

Operation of these structures influencing upon the trustworthiness of non-destructive testing results is featured by the following:

1. Wide temperature range of operational impacts; in this case, the range from minus 60°C to plus 300°C is met most frequently, however, overheating up to plus 450 – 600°C is possible. Moreover, structures subjected to high temperature impact are heated non-uniformly both by length and height.

2. Thermal heating of structure in general and its individual zones varies constantly within small intervals of time.

3. The part of mostly loaded structures, whose destruction can lead the accident with a building, has no direct access for a contact, since it is covered with protective screen.

4. Currently applied technologies do not allow specialists presence on structures in order to pick-up readings without stoppage of production by the following reasons:

- high temperatures in testing zone;
- gas and dust pollution of environment;
- threat to life and health coming from operating technological equipment.

5. The mentality of industrial workers does not allow recording equipment and instruments to be left unattended for long periods of time.

6. Structures are covered by dirt, industrial dust, have several layers of an old paint or are corroded significantly.

7. Structures undergo considerable number of loading cycles (40 to 120 cycles/day) resulting in multiple cracks of fatigue nature, as a rule. In cyclic loaded structures, cracks grow constantly not only in dimensions, but in number as well.

It should be noted that due to inadaptability of currently offered instruments for actual application in the “field” conditions, it is not always possible to make use of nondestructive testing methods. Experience of the “WELD” company in evaluation of technical state of the steel building structures makes it possible to lay down the main requirements non-destructive testing instruments designed for application in actual conditions:

1. Wireless systems with possibility of remote pick-up of readings.
2. Stationary installed long-term (3 – years) use sensors for measurement of temperatures, strains, displacements, thickness.
3. Adjustable mode of readings recording with possibility of simultaneous measurement of n parameters in m points within the given interval of time.
4. Pick-up accuracy of readings given by the user (selected degree of the tested parameter “roughing”).
5. Overall dimensions and weight of instruments must allow operation in space-limited environment and at a height.
6. Possibility of on-surface operation with minimal preparation and even without it at all.
7. Operation temperature range for contact parts of instrument must be from minus 60°C to plus 300 – 600°C depending on possible temperature of structure overheating.
8. Operation in conditions of industrial dust contamination and weak illumination (dust- and water-proofness, bright contrast display).
9. Instrument supply from small-size batteries allowing performance of testing during long time.
10. Data uploading and storing in small-size memory unit (for example, flash-memory) with subsequent data reproduction with personal computer in laboratory conditions.

Solution of these problems will make it possible to extend application field of non-destructive testing during evaluation of the technical state of building structures, increase trustworthiness of obtained information about test objects and reduce the danger of accident destruction of structures.

Specialists of the “WELD” company are ready for contacts with designers of non-destructive testing instruments on the matters of instrument development and their testing in field conditions.