A new scientific trend in general ecology — construction ecology — is currently being established. Construction ecology is called upon to solve a set of problems associated with the influence exerted by man’s building activity on the surrounding ecological medium.

One of the priority tasks of construction ecology is the development of construction methods and procedures that alter natural parameters of the geological medium to a minimum degree. Were it expressed more definitively, man should be taught to enter the environment with the least possible technogenic loadings on the latter.

The First International Congress on Ecology and Geotechnics (Edmonton, Canada, 1994) was the beginning of a new stage in research on the ecology of beds, foundations, underground structures, and soil mechanics.

Federal target and interbranch programs, which apply the topic of discussion, are a critical factor. We can only name the major programs: Construction-Safety Program; Wastes; Radon; the Complex Target Program for Organized Scientific-Technical, Methodological, and Regulatory Provision for a land inventory of cities and other populated locales in Russia, etc.

The concept that we propose for the structure of construction ecology in which basic research objectives are reflected is indicated in the diagram of Fig. 1.

Let us begin with methods of the investigation and assessment of the ecological situation, which occupy the upper rung of the model cited. Traditional geologic-engineering surveys are already a component part of ecological surveys in the modern stage [2-4].

The basic accent in ecologic-engineering surveys is placed on field methods, for example, on sounding. Only a few examples are offered here: Talalei [5] uses a set of geoecological investigations (radiometry, geochemistry) to assess degree of pollution in an area; and, Ulitin [6] proposes to use geoelectrical methods (vertical electric probing, induction profiling) to diagnose natural-industrial systems.

Radiation-ecological monitoring [7, 8], and study of artificial and natural physical fields [9-13], including temperature fields, pathogenic zones, etc., can be classed among special research performed for a particular purpose.

Another branch of the upper rung of the concept of the structure of construction ecology is the assessment and prediction of the ecological situation [14].

Here, the authors refer to the monitoring of groundwater and pollutants, risk assessment, and the methodology of assessment. As for assessment criteria for soil contamination, and also natural sources of risk to human, animal, and plant health, [8], there have been no purposeful investigations to date in either Russia or abroad, but only individual publications [8], [15], and [16]. For land, requirements for the monitoring of pollution have been developed on the basis of limiting allowable concentrations (LAC) in accordance with GOST 17.4.1.03-84; standards for permissible amounts of polluting substances in contiguous natural media and in agricultural production, and indicators of the sanitary condition of land in accordance with GOST 17.4.2.01-81.

One method of predicting the ecological situation is the observational method, which is incorporated in Eurocode 7. Morgenstern [17] has developed an observational method for ecology in geotechnics.
The leading role in solving problems of construction ecology belongs to geotechnics. The implementation of protective measures calls for conventional engineering actions, including the building of levees, berms and terraces, settling basins, and diking. Coverings, and also anti-seepage curtains are built beneath equipment to reduce harmful infiltrations to the ground. Concrete, asphalt, clays, and various plastic membranes are used as coverings.

Vertical underground walls and anti-seepage curtains constructed of cement-bentonite, soil-bentonite, etc., by the “wall-in-the-ground” method are frequently used. Walls are employed to install continuous (circular) enclosures around toxic substances existing in a soil mass when evacuating water from the latter for purification. Walls are also constructed linearly to direct underground flows in the desired direction.

A distinct example of the use of geotechnics is the 10-year program for the dredging of soil and installation of disposal areas in Hong Kong [18], where it is proposed to process 450 million m$^3$ of soil, and in Europe [19], where the reclamation of hydraulicked soils assumes exceptionally high significance. In Holland [19], for example, more than 45 million m$^3$ of hard precipitated particles must be removed annually from the sea. These figures are 10-20 times higher for Europe; in that case, 25-30% of these accumulations are contaminated, although only a small part is highly contaminated.

At the present time, three methods are used to purify contaminated soils: chemical, thermal, and biological.

The chemical method with use of peroxides is employed for sandy soils in which the clay and humus content does not exceed 10-15%.

The thermal method is used for soils containing an organic material, which is either evaporated, or broken down to volatile components that can be removed in subsequent stages of purification. This method does not come into very widespread use, since both organic and inorganic substances are usually contained inumps, and its cost is high.

Ecological purification has come into widespread use in Holland to clean pumps of organic contaminants, especially petroleum derivatives. The principle of purification consists in the blow-through (ventilation), and combined blow-through with biodecomposition, for which microorganisms transform the pollutants into water and carbon dioxide. Use of the method is limited by the existence of nondecomposable organic compounds of heavy metals in the pumps.

One of the basic problems solvable by construction ecology is that of wastes. According to data of the Federal Target Program “Wastes,” approximately 7 billion tons of wastes are formed in the Russian Federation each year; in that case, 2 billion tons, i.e., approximately 28%, are re-used. Of the overall volume of reusable wastes, approximately 80% — overburden rock and concentration wastes — are earmarked for the filling of the worked space in mines and quarries, 2% has found use as fuel and fertilizers, and only 18% or 360 million tons are used as secondary raw material, of which 200 million tons goes into the construction industry. The volume of possible waste utilization depends primarily on the degree and potential of their purification.

The purification of wastes is usually an even more complex problem than the purification of soils; however, the arsenal of possible methods of purification is extremely narrow at the present time. The waste problem is therefore solved primarily by the installation of open and closed storage facilities.

Here, it must be pointed out that such an important problem as use of industrial wastes is hardly resolved. Economically spurred lack of interest by establishments, low production level, and lack of modern processing equipment have resulted in the fact that an insignificant portion of wastes is reused, and the rates of their formation and accumulation in our country remain unchanged.

As for waste purification, let us point out the method of purification of petroleum-containing sands by means of reclamation [20], and methods of protecting structures from methane and other gases during construction on fill soils [22].

The problem faced by the designer consists in selecting safe measures, while simultaneously retaining their economic expediency.

Possible methods of protection include the following: removal of all contaminated soil from the site and its export to an area where it cannot cause harm; creation of a type of “wall-in-the-ground” or diaphragm barrier to insulate a room from a contaminated section. In many cases, a solution in which all measures for protection from gases are specified directly in the room being protected is best.

These measures include the following: a protective membrane, a ventilated cellar with a membrane, and a ventilated gravel cushion with a membrane. In that case, the ventilation may be both active, and passive, and the installation of just one membrane is usually insufficient.

Dumps containing various wastes are engineering structures with a high risk potential as a result of toxic and harmful components. Engineering solutions are used for dumps where the pollution of air, soil, and groundwater is prohibited.

The first problem, which should be solved, is the selection of a proper site.