Таблица 2/Table 2.

Ущерб по отдельным объектам
Damage to some structures

Объекты работ	Ущерб рыбным запасам (кг) / Damage to fish resources (kg)		
	Московская область / Moscow Region	Смоленская область / Smolensk Region	Всего: Total: 1
1. Ремонт и реконструкция больших мостов (repairs and reconstruction of large bridges)	-	1769,4	1769,4 (51,75%)
2. Ремонт и реконструкция средних и малых мостов (repairs and reconstruction of medium and small bridges)	-	774,5	774,5 (22,65%)
3. Ремонт и реконструкция малых мостов на ручьях (repairs and reconstruction of small bridges over brooks)	23,5	63,2	86,7 (2,54%)
4. Переустройство мостов на ручьях на трубы (replacement of bridges over brooks for tubes)	43,1	51,5	94,6 (2,76%)
5. Замена существующих труб на новые (replacement of tubes for the new ones)	40,5	54,3	94,8 (2,77%)
6. Ремонт и реконструкция труб на ручьях и реках (repairs and reconstruction of tubes at brooks and rivers)	66,5	532,9	599,4 (17,53%)
ВСЕГО: TOTAL:	173,6	3245,8	3419,4 (100%)

борке временных перемычек в руслах малых водотоков. Значителен также ущерб за счет работ на большом количестве малых водотоков. Ущерб на малых водотоках вызван уничтожением почвенно-растительного покрова на прилежащих к руслу участках поймы.

Ущерб от потери пойменных угодий при отсыпке строительных площадок на затапливаемых в паводок участках доходит до 18% общих потерь, от гибели кормовых организмов на площадях дна, отторгаемых или повреждаемых при работах в русле (отсыпка временных дамб, устройство временных опор, канализация русла) – около 9%.

Анализ структуры прогнозируемых потерь показывает, что негативное воздействие наводные и околоводные биоценозы может быть снижено на 15–18%, если вынести строительные площадки в незатапливаемую часть поймы и уменьшить площади повреждения почвенно-растительного покрова по берегам ручьев при сооружении на них дамб-перемычек.

Снятие остаточного слоя защитного покрытия моста – сложный технический процесс, требующий значительных затрат расходных материалов, а также человеческого труда. Отсюда следует, что любой ремонт металлических мостовых конструкций не только предполагает большие денежные затраты, но и окажет негативное влияние на окружающую среду и человека, поскольку эти работы оставляют большое количество отходов, трудно поддающихся утилизации [3]. То есть и здесь безопасность труда и экология оказываются в одной связке.

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ON THE LABOR ENVIRONMENT OF BRIDGE BUILDERS

Agapov, Andrey G. *– aerodrome construction and reconstruction project manager of Aerocom company, Moscow, Russia.*
Dashkevich, Ivan M. *– fourth-year student of Moscow State University of Railway Engineering (MIIT), Moscow, Russia.*

ABSTRACT
Interrelation of labor safety and of environment has always been a leading factor for profession of bridge builders who conduct construction and repair works at the railway installations. Cartogram of working conditions and analytic data permit the authors to classify this professional group as subject to injuries and risks.

ENGLISH SUMMARY
Background. *At the majority of railway enterprises the conditions of labor environment are conform to the rules and standards of sanitary laws. But the workspaces of bridge builders aren't always well-organized, neither sanitary norms are respected during current operations at the bridges.*
Objectives. *First, the authors would like to assess average time of safe work, then to assess the impact of bridge works on fish resources, finally to give recommendations how to avoid or minimize negative consequences.*
Methods. *The article uses statistical analysis and mathematical methods of probability theory.*

Results. *1. Analysis of accidents in bridge-building organizations during the period of 1993–2012 shows (fig. 1), that injury rate is still high. This is explained by the growth of complexity of construction and mounting operations, acceleration of construction, reduction of the level of industrial engineering quality, reduced professional skills of managers and workforce [1].*

Now more 47% of bridge-building teams have 20–30 years old workers. The number of experienced mounters (45 years and older) has decreased.

The job of bridge builders is intensive. Analyzing functions of a man (hearing, vision) should correspond to the requirements for narrowly looking, attentively listening while conduction the works [2].

The cartogram of working conditions of bridge-building men demonstrates (fig.2) which factors have negative impact. It is quite clear what to do – it is necessary to make industrial environment healthier, to decrease intensity of job, to create a complex system of actions providing for optimization of job operations of bridge-builders.

Job conditions which violate the existing sanitary standards and rules of safety engineering may cause injuries or professional diseases.

Periods between job injuries and professional diseases are not constant, they should be deemed to be variable and random, and the intervals between disability cases can be called time of safe work. Injuries and diseases have different consequences and the time of recovery is also a variable value that depends on the character of injury, heaviness of relapse, individual features and other factors (promptness of emergency services, relevance of curing methods etc.).

As, while determining time of safe work, it is necessary to find variables, then it is possible to use probability theory that permits substantiating a level of industrial safety. According to the theory, the labor activity of a team is considered as a system that is fault-free between the cases of injury or professional diseases. IN other words working conditions is assessed by time from the beginning of the yeas till first case of injury, then by time between first and second case of injury etc.

If injuries occur with almost even time intervals, then probability of safe work P during assigned time is calculated by expression:

$P = (1 - T_з / NT)^n$,

where $T_з$ – an assigned time interval for which value P is determined; N – number of teams or areas of bridge-building; n – number of injuries in N teams during T time.

The results of calculations provide for relative job safety during the period $T_з$ if $P \leq 0,95$. If $P < 0,95$, there is no certitude that the work is safe. Table 1 demonstrates that different occupations have different probability of safety during an assigned time interval. Knowing relative probability of danger for a certain team service of labor protection can proceed with preventive actions.

When the intervals between injuries or professional diseases are not clearly stable, it is necessary to increase the number of studied cases including data on other teams, but the studied period should not exceed three years.

2. Construction and reconstruction works held at man-made structures affect watercourses. Most evident consequences are:

– change of a stream due to obstruction of the bed;

– temporary opacity growth due to development of underwater trenches, foundation pits, damming and temporary diversion of the stream causing oppression and death of hydrocole;

–clogging of stream and bottomland with rubbish, building waste while erecting temporary supports, sandblast cleaning;

– contamination of waters by storm run-off of railroad bed;

– violation of soil-vegetable cover of stream and bottomland;

– poaching etc.

The majority of enlisted factors can be avoided or minimized with the help of general nature protection measures. But even in that case it is not possible to completely eliminate negative impact and to avoid damage to fishing resources. It is rather possible to compensate the damage by special actions aimed at making up of fish productivity of water resources. In order to assess damage which is caused by crossing of watercourses by railways, the objects are grouped according to planned works. For instance the damage to several objects (typical situation, Smolensk section of Moscow railway) is represented in table 2. More than a half of losses (51,75%) are caused by reconstruction of large bridges, 22,65% by reconstruction of small and medium bridges, 25,6% by reconstruction and repairs of bridges and tubes over brooks and little rivers.

Conclusions.

1. Data on cumulated risks of injury during the year permit to distribute more correctly the funds for sanitary measures.

2. Analysis of the structure of supposed losses proves that the negative impact for water and underwater biocenosis could be reduced by 15–18% if construction sites are moved to the part of a bottomland which is not subject to floods.

Key words: labor safety, bridge works, cartogram of working conditions, traumatism, injury, ecological damage.

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Координаты авторов (contact information): Агапов А. Г. (Agapov A. G.) – andrei5551@yandex.ru, Дашкевич И. М. (Dashkevich I. M.) – ivandashk@yandex.ru.

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