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Biomechanical approach to improving safety of working conditions at non-stationary workplaces in railway transport (on the example of the workplace of train components)

Kh.M. Kamilov[1][a]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: The article thoroughly examines the work activities of train compilers working in non-stationary workplaces within the railway transport system, the ergonomic safety conditions, and the impact of professional factors. In particular, the actions of train compilers related to the stairs and railcar handles, static and dynamic loads, and the anthropometric and biomechanical inconveniences they encounter during the work process were analyzed. In accordance with the current standards OST 24.050.67-87 and GOST 12.2.049-80, the design shortcomings of wagon handles, in particular, ergonomic inconveniences during reliable hand gripping, and shortcomings in protection against slippage and thermal effects, have been substantiated. Based on the research results, the need to redesign the handles based on ergonomic biomechanics requirements to ensure safe and efficient work for train assemblers has been substantiated.

Keywords: train components, wagon ladder, handle, anthropometry, biomechanical

Temir yo‘l transportida turg‘un bo‘lmagan ish o‘rinlarining mehnat sharoitlari xavfsizligini oshirishda biomexanik yondashuv (poyezd tuzuvchilar ish o‘rni misolida)

Kamilov X.M.[1][a]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Maqolada temir yo‘l transporti tizimidagi turg‘un bo‘lmagan ish o‘rinlarida faoliyat yurituvchi poyezd tuzuvchilarning mehnat faoliyati, ergonomik xavfsizlik sharoitlari va kasbiy omillar ta’siri chuqur o‘rganilgan. Xususan, poyezd tuzuvchilarning vagon zinapoyalari va tutqichlar bilan bog‘liq harakatlari, ish jarayonida duch keladigan statik va dinamik yuklamalar, antropometrik va biomexanik noqulayliklar tahlil etilgan. Amaldagi OST 24.050.67–87 va GOST 12.2.049–80 me’yorlariga muvofiq vagon tutqichlarining konstruktiv kamchiliklari, xususan, qo‘l bilan ishonchli ushlashdagi ergonomik noqulayliklar, sirpanish va issiqlik ta’siridan himoyalanishdagi yetishmovchiliklar asoslab berilgan. Tadqiqot natijalari asosida poyezd tuzuvchilarning xavfsiz va samarali mehnatini ta’minlash uchun tutqichlarni ergonomik biomexanika talablari asosida qayta loyihalash zarurati keltirib o‘tilgan.

Kalit so‘zlar: poyezd tuzuvchi, vagon zinapoyasi, tutqich, antropometriya, biomexanik

1. Kirish

Temir yo‘l transporti har qanday mamlakat iqtisodiy infratuzilmasining ajralmas va strategik jihatdan muhim tarmog‘i hisoblanadi. So‘nggi yillarda kuzatilayotgan barqaror iqtisodiy o‘sish hamda xalqaro miqyosda tovarlar ayirboshlash hajmining ortib borishi temir yo‘l transportiga bo‘lgan ehtiyoj va yuk tashish talabining sezilarli darajada oshishiga olib kelmoqda. Ushbu tizim orqali yuk va yo‘lovchi tashishni samarali tashkil etish, poezdlar harakati xavfsizligini ta’minlash va transport operatsiyalarining uzluksiz ishlashini kafolatlashda turg‘un bo‘lmagan ish o‘rinlarida mehnat faoliyatini olib boruvchi mutaxassislarning roli alohida ahamiyat kasb etadi. Bu turdagi ish o‘rinlarida band bo‘lgan xodimlarning faoliyati temir yo‘l transporti tizimining uzluksiz ishlashi, texnologik jarayonlarning muvofiqligi va xavfsizlik talablariga rioya etilishi uchun zarur bo‘lgan asosiy inson omili sifatida qaraladi.

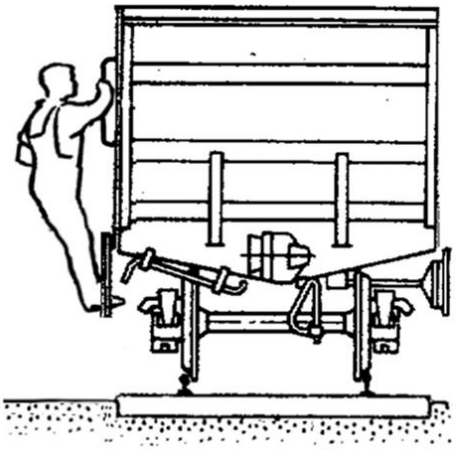
O‘zbekiston Respublikasi Vazirlar Mahkamasining 2014-yildagi 15-sentabrdagi “Xodimlar mehnatini muhofaza qilish chora-tadbirlarini yanada takomillashtirish to‘g‘risida” 263-son qarori bilan tasdiqlangan “Ish o‘rinlarini mehnat sharoitlari va asbob-uskunalarning jarohatlash xavfliligi yuzasidan attestatsiyadan o‘tkazish tartibi to‘g‘risida”gi Nizomida keltirilgan asosiy tushunchalarga muvofiq turg‘un bo‘lmagan ish o‘rinlari bu hududiy o‘zgarib turadigan ish zonalaridagi ish o‘rinlari, bunda bir yoki bir necha xodimlar xususiyatiga ko‘ra o‘xshash ish yoki operatsiyani bajaradigan ishlab chiqarishning zarur vositalari bilan jihozlangan ish o‘rnining bir qismi ish zonasi deb hisoblanishi keltirilgan. Shunga ko‘ra, temir yo‘l transporti orqali tashish jarayonini tashkil etish va poezdlar harakati xavfsizligini ta’minlashda poyezd tuzuvchilarni xizmati o‘ta muhim o‘ringa ega [1].

[a] https://orcid.org/0009-0009-2998-3964

Lavozim vazifasi talablaridan kelib chiqqan holda poyezd tuzuvchilari o‘z faoliyati davomida manyovr ishlarini bajarayotgan lokomotiv harakatini boshqarish, manyovr ishlarida ishtirok etayotgan ishchilarning to‘g‘ri joylashishi va harakatlarining muvofiqlashtirilishini ta’minlash, temir yo‘lda harakatlanuvchi tarkiblarni (vagon guruhlarini) tarqatish va shakllantirish bo‘yicha manyovr ishlarini amalga oshirish; vagonlarni poyezdlarga tirkash va ajratish, vagonlarni yuk ortish-tushirish va boshqa maxsus yo‘llarga kiritish hamda bu yo‘llardan olib chiqish, vagonlar va tarkiblarni bir yo‘ldan boshqasiga, bir parkdan boshqasiga o‘tkazish, poyezdning avtomatik tormoz tizimini sinab ko‘rishda ishtirok etish, temir yo‘l stansiyasi yo‘llarida tarkiblar va vagonlarni mahkamlash uchun tormoz boshmoqlarini joylashtirish (olish), manyovr ishlarini bajarish paytida xizmat ko‘rsatilmaydigan markazlashmagan strelkali o‘tkazgichni boshqarish, saralash tepaligidan tarkiblarni tarqatishda vagonlarni ajratish jarayonlari bilan shug‘ullanadi [2].

2. Tadqiqot metodologiyasi

Poyezd tuzuvchisining ishi bir qator kasbiy omillarning (noqulay meteorologik sharoitlar, shovqin, tebranish, past yorug‘lik, jismoniy og‘irlik, ruhiy zo‘riqish va boshqalar) ta’siri bilan bog‘liq. Poyezd tuzuvchisining mehnat jarayoni davomida olib boradigan ish faoliyati og‘ir mehnatga kiradi. Ular smena davomida tik turgan holatda poyezdlarni shakllantirishda ko‘plab masofani (shu bilan birga qishda kiyim-kechak va jihozlarning og‘irligi bilan) bosib o‘tadilar, balandligi 0,7-1,0 metrgacha bo‘lgan vagon zinapoyasiga smena davomida juda ko‘p marotaba chiqib tushadi. Dinamik ishdan tashqari ularning mehnat faoliyatida katta statik yuklama ham mavjud. Bunga vagon zinapoyasida manevr ishlarini bajarayotganda tutqichni ushlab tik turgan holatdagi tana og‘irligini ushlab turishi va avtotirkamalarni ajratishda kuch sarflashi kiradi. Ko‘p hollarda u vagon zinapoyasi pog‘onasiga tayanib, qo‘llari bilan tutqichni ushlab osilib turishiga to‘g‘ri keladi. Amaliyotda tez-tez uchraydigan vagon zinapoyasining qiyalik burchagida vaziyat yanada murakkablashadi. Bunday holatda poyezd tuzuvchisining o‘z tanasi, maxsus kiyimi, signal va aloqa vositalarining asosiy og‘irligi uning qo‘llari yordamida vagonda ushlab turiladi. Signal berish paytida esa (ratsiya, bayroqcha yoki hushtak orqali) bu vazifani faqat bir qo‘li bilan bajaradi (1-rasm).



1-rasm. Poyezd tuzuvchining mehnat jarayonini olib borishdagi holati

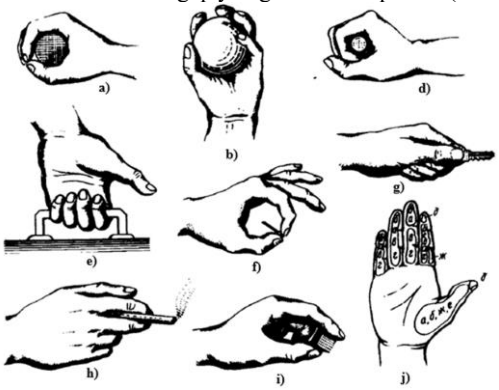
Ma’lumki, temir yo‘lda harakatlanuvchi tarkibni ishlab chiqaruvchi zavodlar OST 24.050.67-87 “Yuk vagonlarining narvonlari, zinapoyalari va tutqichlari. O‘lchamlar va umumiy texnik talablar” [3]ga muvofiq, belgilangan tartibda konstruktorlik hujjatlari asosida ularni tayyorlaydi. OST 24.050.67-87ga ko‘ra, vagonlarning narvonlari, zinapoyalari va tutqichlarining konstruksiyalarini manevr, ortish-tushirish ishlarida, vagonlarga texnik xizmat ko‘rsatish va ta’mirlashda xizmat ko‘rsatuvchi xodimlarning xavfsiz mehnat sharoitlarini ta’minlaydigan tarzda ishlab chiqishni talab qiladi, asosiy turdagi vagonlarning ushbu konstruktiv elementlarining majburiy nomenklaturasini, ularning maqsadi va joylashuvini belgilaydi.

Hozirgi vaqtda temir yo‘l tarmog‘ida ishlatilayotgan ko‘plab vagonlar poyezd tuzuvchilarining mehnat xavfsizligiga ta’sir qiluvchi konstruktiv (tutqichlar ushlash uchun noqulay, vagonlardagi zinapoyalar juda baland hamda g‘ildirakka bevosita yaqin joylashgan) kamchiliklarga ega. OST 24.050.67-87ga asosan [3], poyezd tuzuvchisi foydalanadigan vagon tutqichi quyma dumaloq shaklda, butun uzunlik bo‘ylab bir xil diametrli ishchi qismdan iborat bo‘ladi (2-rasm).

2-rasm. Poyezd tuzuvchisining vagon tutqichini ushlab turish holati

Tutqichlardan foydalanayotganda uni to‘g‘ri ushlash muhim ahamiyatga ega. Ushlash usullarining bir necha tasnifi mavjud. Byusse [4] tasnifiga ko‘ra, bu usullar mexanizmlarga o‘xshashligi bo‘yicha 6 ta asosiy toifaga bo‘linadi. Olib borilgan [5] tadqiqotlarda 9 turdagi ushlash usuli taklif etilgan. 12 va undan ortiq turdagi ushlashlardan foydalangan ilmiy ishlar ham bor. Eng sodda holatda barcha ushlashning ikki guruhga ajratiladi: kuch ishlatadigan va aniqlikka asoslangan [6].

Amaliy nuqtayi nazardan qulay tasnif I. Matev va S. Bankov tomonidan taklif etilgan bo‘lib, ushbu tasnif bo‘yicha ushlashlarning quyidagi turlari farqlanadi (3-rasm).



3-rasm. Ushlash usullari:
a – silindrsimon; **b** – sferasimon; **d** – mushtlab; **e** – ilmoqli; **f** – barmoq uchlarida; **g** – kalitli; **h** – qaychisimon; **i** - palmar (kaft); **j** - har xil turdagi ushlashlarda kaftning kontakt zonalari

Keltirilgan ushlash usullari tutqichlarni ushlashning barcha mumkin bo‘lgan usullarini to‘liq qamrab olmaydi. Turli buyumlarni ushlab turish va ulardan foydalanish bo‘yicha olib borilgan tajribalarda quyma dumaloq shakldagi tutqichlarni mushtlab ushlash [6] qo‘l bilan ishonchli va qulay ushlashni ta’minlamasligi, ayniqsa nam, sovuq sharoitlarda yoki qo‘lqop kiyilganda qo‘lning sirpanishini oldini olishda samarasiz hisoblanishi, shuningdek, issiq sharoitlarda qo‘l terisida kuyish xavfini yuzaga keltirishi ta’kidlangan. Bu esa kasbiy faoliyat samaradorligini pasaytiradi hamda charchoqni kuchaytiradi.

3. Xulosa

GOST 12.2.049-80 “Ishlab chiqarish uskunalari, umumiy ergonomik talablar” [7] bo‘yicha ish joyini rejalashtirish xodimni ayrim harakatlardan ozod qilishi, qulay bo‘lishi va uning antropometrik ma’lumotlarini hisobga olishi kerak. Biroq, eng oddiy holatlarda, hatto vagon tutqichini ushlab turishi poyezd tuzuvchisiga noqulaylik tug‘dirishi mumkin. Shunday bo‘lsa-da, yangi harakatlanuvchi tarkibni loyihalash va ishlab chiqarish bosqichlarida poyezd tuzuvchilarining mehnat sharoitlarini sanitar-gigiyenik qoidalar va me’yorlar talablariga to‘liq mosligini ta'minlash yuzasidan ish joyini ergonomik biomexanika qonuniyatlari asosida ishlab chiqish e’tibordan chetda qolmoqda. Shu sababli, poyezd tuzuvchilar mehnat faoliyatida foydalaniladigan tutqichlarni loyihalashda ularning konstruktiv shakliga, shuningdek, yuqori harorat sharoitida foydalanish imkoniyatini ta’minlashiga alohida e’tibor qaratilishi lozim.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Kamilov Xasan / Khasan Kamilov
Toshkent davlat transport universiteti “Texnosfera xavfsizligi” kafedrasi dotsenti, t.f.f.d., (PhD), dotsent
E-mail: xasan-kamilov@mail.ru
Tel.: +998977209944
https://orcid.org/0009-0009-2998-3964

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