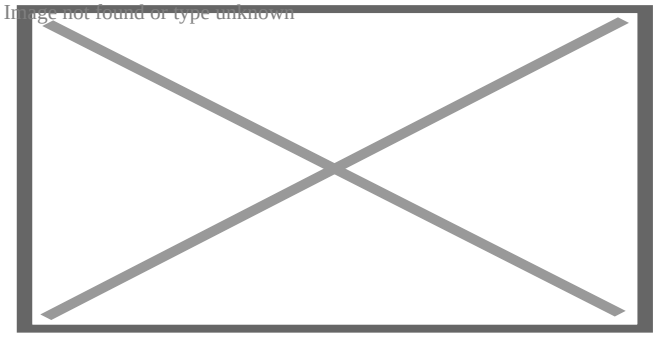
?????????? ???????????? «????????», «??????», «????», ??????? ?????????????? ?? ???????? ??????? ??????, ????? ??????? ?? ?????????? ????????? ??????? (???. 1).



???. 1. ??????? ???????????? ??1 («????????»): 1 – ???? ???????; 2 – ??????? ???????? ??????? ????????? ???????????; 3 – ?????; 4 – ???????? ????; 5 – ???????; 6 – ???????????; 7 – ?????; 8 – ????????????;
/9 – ???????? ????????? ??????? ???????;10 – ???????? ????????? ???????? ???????; 11 – ???????? ????????? ?????????? ??????? ????????? ????????????

Fig. 1. Trolley of the ES1 electric train ("Swallow"): 1 – trolley frame; 2 – spring of the axle box stage of spring suspension; 3 – axle box; 4 – wheelset; 5 – leash; 6 – silent block; 7 – body; 8 – pneumatic cylinder; 9 – dampener of vibrations of wagging of the trolley; 10 – vibration dampener of the axle box stage; 11 – vibration dampener of the central stage of the spring suspension

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- ????????? ?????? ????????? ??????????? ????????? ?????????? ??????????? ????????? (???. 2?);
- ??????????? ????? ???????? ????, ? ??????? ??????????? ????????? ??? ????????? ?????? ??????? ?? ??????????? ????????. ??? ???? ?????? ????? ??????? ??????????? ? ????? ??????? ???????? (???????) ?????????????????? ???????? (???. 2?).

? ?????? ?????????????? ??????????? ????????? ????????? ????????? ????????? ????????? ????? (??????????? ? – ??. ???. 2) ???????? ???? ? ????? ??????? ? 20,0 ??/?? ?? 5,0–8,5 ??/??. ? ??????? ???? ? ?????? ???????? 300 ?, ??? ???????? ????????????, ????? ????????? ? 10 ?? ?? 6,7 ??, ????????? ?????? (?????? ??????) ??????? ????? ? ??????? – ? 1,4–1,6 ??? [3].

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?) ?)

???. 2. ???????? ??????????? ????????? ???? ???????: 1 – ???????; 2 – ?????; 3 – ???? ???????;
4 – ??? ???????? ????; 5 – ??????????? ?????????; 6 – ????????? ?????????;
7 – ??????? ?????????????????? ??????; 8 – ??????????? ?????????????????? ?????? (??????????)

Fig. 2. Options for upgrading the axle box of the trolley: 1 – leash; 2 – axle box; 3 – trolley frame; 4 – wheelset axle; 5 – spherical bearing; 6 – cassette bearing; 7 – standard rubber–metal hinge; 8 - spherical rubber-metal hinge (silent block)

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???. 3. ??????? ??????????? ??????? «????????»: 1 – ???? ???????; 2 – ??????? ???????? ??????? ????????? ???????????; 3 – ?????; 4 – ???????? ????; 5 – ???????; 6 – ??????????????? ??????????;
7 – ???????? ??????; 8 – ????????? ??????; 9 – ??????? ??????? (??????); 10 – ????? ?; 11 – ?????

Fig. 3. Upgrade option for the Swallow trolley: 1 – trolley frame; 2 – spring of the axle box stage of spring suspension; 3 – axle box; 4 – wheelset; 5 – leash; 6 – combined silent block; 7 – outer sleeve; 8 – inner sleeve; 9 – elastic element (rubber); 10 – gap ?; 11 – body

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?? ????? ?????????? ????????????? ??????????? ? ????????? [4] ???? ??????????, ??? ??-?? ?????????? ?????????? ??????? ?????????? ???????? ????? (?.?. ?? ????????) ??????????? ???? ??????? ? ?????? ???????? ????, ?? ?????? ???????? ? ??? ????????? ????????? ???????, ???????????? ????????? ??????? ??????. ??? ??????? ???? ????????? ???? ????, ? ?????? ???????? ????????????, ?????????? ????????? ???????? ????????? ????????? ?????????:

- ????????????? (??????????) ???????????? ????? ?????? ? ????? ???????;
- ????????????? (??????????) ????????????, ???????????? ????? ??????????????? ???? ? ????? ??????? (?? ???????? ??????? ????????? 2??25? «??????»);
- ????????????? ????????????? ??? ?????????? ???????? ?????? ?????? ??????????? ???? ???????.

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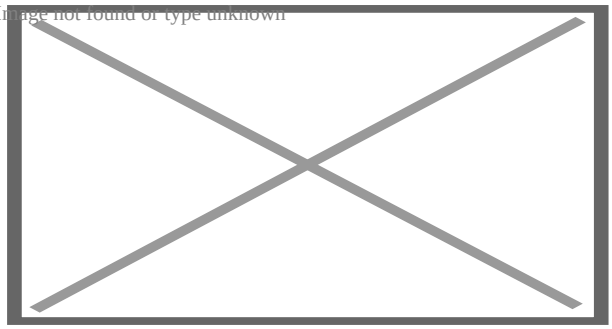

???.4. ???????? ??????? ??? (*Y*?) ?????? ???????: ??????? ??????????;
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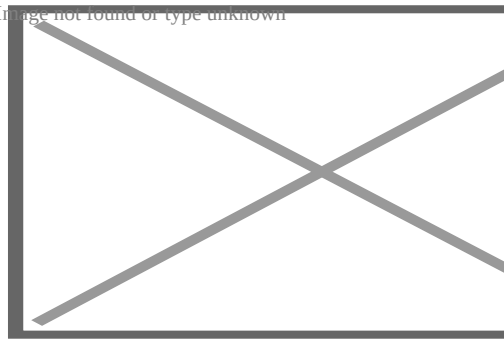
??????? $?_{????}$:
$?_{????}$ = 6,0 ??/??, $?_{????}$ = 4,0 ??/??,
$?_{????}$ = 2,0 ??/??, $?_{????}$ = 1,5 ??/??

Fig.4. Values of lateral forces (Yb) of the crew model:
standard design; with crew elements with radial wheelset and rigidity
of the longitudinal coupling of the
axle box with the trolley frame S_{long} :
S_{long} = 6,0 kN/mm, S_{long} = 4,0 kN/mm,
S_{long} ? = 2,0 kN/mm, S_{long} = 1 kN/mm



???. 5. ???????? ??????? ?????? (*T*gamma) ???
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? ????????? ??????? ? ???? ? ????????? ?????????
??????? $?_{????}$:
$?_{????}$ = 6,0 ??/??,
$?_{????}$ = 2,0 ??/??,

Fig.5. Values of the crew model wear factor(
standard design; with crew elements with radia
of the longitudinal coupling of the axle box with the t
S_{long} = 6,0 kN/mm,
S_{long} ? = 2,0 kN/mm,

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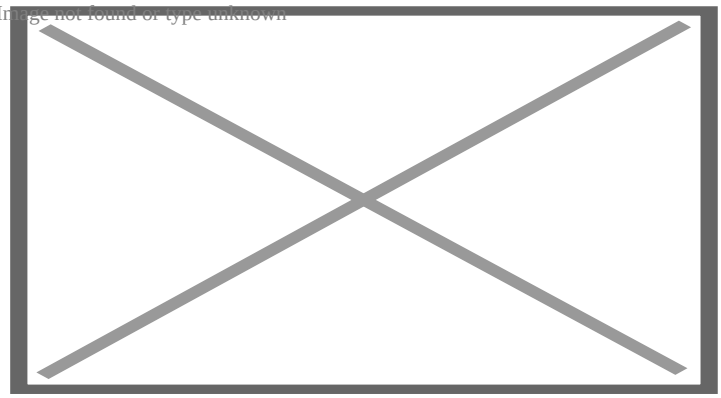


???. 6. ???????? ????????????? ????????? ?????? ???????: – ??? ????????????,
– ??????? ??????????;

F?? = 3 ??

– Ж$_{прод}$ = 6,0 кН/мм,
– ?$_{????}$ = 4,0 ??/??,
– ?$_{????}$ = 2,0 ??/??,
– ?$_{????}$ = 1,5 ??/??

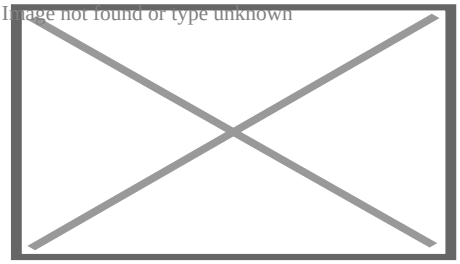
Fig. 6. Values of horizontal accelerations of the crew model:: – two hydraulic dampers,
– standard design;

Fr = 3 *kN*

– S_{long} = 6,0 kN/mm,
– S_{long} ? = 4,0 kN/mm,
– S_{long} ? = 2,0 kN/mm,
– S_{long} = 1 kN/mm

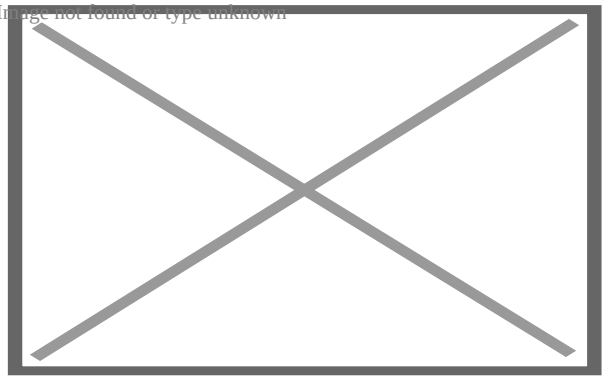
??? ???????? ????? ?????????? ??????????? [4], ????????????? ???????? ????????? ? ?????? ???????? ????? ???????? ????????? ?????? ?????? ?? ??????????? ?????????? ???? ??? ??????? ?????????. ??????? ????? ???????? ????????? ??? ???????? ??? ?? ? ????????? ???????? ????????? ????????? ?? ??????????

??????. ?????? ????????? ? ???? ?????? ????? ???? ????????? ?????????? ????????, ????????? ???? ?????? ?? ????? ???????? ?? ??????? ?? ???????? ??? ??????????, ?? ???????? ?????????? ???????? ??? ????? ????????? ? ????????? ?????????? ?????. ? ?????????? ??????? ????????? ??? ????????? ???????? ???????? ????????? ?????? ??????????? ? ?????????????? ????????? ??????????? ????????? ??????? ????????? ???? ? ?????????????? ??????????. ?????????????? ????????? ??????????? ? ????? ????????? ?????? ??????????? ???????? ????????? ????? ????????? ? ??????????? ? ???. 7, ?? ???????? ? ????????? ?????????????? ????????? ????????, ?????????????? ?? ????????? 2??121[5] ? 2??116 ?1369 ? ???? [6]. ?????????????? ??????????, ??? ?????????? ???????? ???? ?????? ($F_{??}$) ?? ????? ??????????? ????????, ?????????????? ?????????? ?????????????? ????????, ?????? ???? ????? 3 ?? (???. 8–10). ? ???? ?????? ???? ??? ???????? ???????? 160 ??/? ?? ???? ???? ????????? 0,12 *g*, ? ????????? ???? – 3,25.



???. 7. ?????????? ???????? ?????????: 1 – ????????? ?? ??????? ??????;
2 – ????????? ?? ????????? ????? ???? ???????; 3 – ???? ??????????? ???????? ?????????;
4 – ????????; 5 – ???????? ???????; 6 – ????????????

Fig. 7. Friction vibration dampener: 1 – bracket on the body bolt; 2 – bracket on the crossbeam of the trolley frame; 3 – rod of the friction vibration dampener; 4 – plates; 5 – pressure spring; 6 – guide rail



???. 8. ???????? ?????????????? ????????? ?????? ???????:

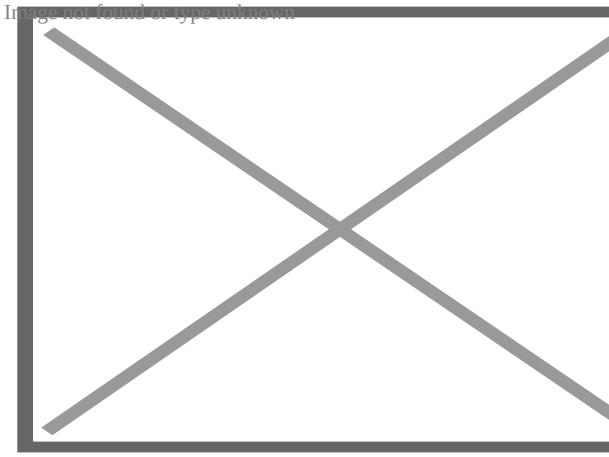
– $?_{????}$ = 6,0 ??/??,

F?? = 3 ??

– $Ж_{прод}$ = 4,0 кН/мм,

– $?_{????}$ = 2,0 ??/??,

– $?_{????}$ = 1,5 ??/??



???. 9. ???????? ?????????? ????????? ???? ? ??????? ?????? ???????:

– $?_{????}$ = 6,0 ??/??,

F?? = 3 ??

– $Ж_{прод}$ = 4,0 кН/мм,

– $?_{????}$ = 2,0 ??/??,

– $?_{????}$ = 1,5 ??/??

Fig. 8. Values of horizontal accelerations of the crew model:

Image not found or type unknown $S_{long} = 6{,}0\ kN/mm$, Image not found or type unknown

Ffr = 3 kN

Image not found or type unknown $S_{long} = 4{,}0\ kN/mm$,
Image not found or type unknown S_{long} ? = 2,0 kN/mm,
Image not found or type unknown $S_{long} = 1\ kN/mm$

Fig. 9. Values of the smoothness index in the horizonta
model:

Image not found or type unknown $S_{long} = 6{,}0\ kN/mm$, Image not found or type unknown

Ffr = 3 kN

Image not found or type unknown $S_{long} = 4{,}0\ kN/mm$,
Image not found or type unknown S_{long} ? = 2,0 kN/mm,
Image not found or type unknown $S_{long} = 1\ kN/mm$

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???????????? ???????? ??????? ???????????? ??????? ?????????????????? ???????, ????????????? ??????????????? ? ???????? ? ??????? ??????????? ?????? ???????? ????, ???????? ??????????? ??????? ????? ??????? ????? ? ???????. ????????????? ????????????? ? ??????? ?????????? ????????? ???????? ??? ?????????????? ????????????? ?????????? ??????? ?? ?????? ? ??? ? ??????, ?? ? ?? ???????.

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