BEARING CONSTRUCTION OF PASSENGER'S SEAT, AND THE ACCT/AFFECT OF THE SAFE AREA DURING THE BUS'S ACCIDENT

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Abstract: *This paper investigations detail analysis of the influence the type of construction and the way of fixing seat bearers on basic bus construction and its superstructure. Before performing experimental investigations it was modeling of tension-deformation condition of across frame made by using Finite Element Methods. During experimental investigations on basis of this analysis it was founded three measuring points where deformations were measuring. According results from experimental investigations it was third type of seat bearers allowing raise of safety area of bus passenger's.*

Keywords: SEAT BEARERS, ACROSS FRAME, DEFORMATION, PASSENGER'S SAFETY AREA

1. Introduction

Static investigations of bus across frame are for definition of side frame of bus superstructure made, for less weight construction which will be ECE standards satisfied. These investigations are for aspect of passengers safety area satisfied in condition of bus turning over.

For investigations of the influence of seat bearers on static bearing of superstructure side frame, were three side frames from the same material made, quality x5CrNi1810, with real frame bus dimensions. The time of experiments the seat bearers were put on the basis of bus construction and the frame of the bus. Three types of constructive bearer's seat were used. By static experiments of frames were F-l diagrams obtained (Deformation the frame depending from the Force which it's loading). By continuously measuring the deformations of measuring frame points (places) were curve deformation obtained which are passenger's safety area defined.

Experimental investigations[2] were by normal force which is acting in the upper area of the frame done, where is this force action during the bus's accident (overturning) expected. Steel cord appointing direction of the force action, is around 15^0 for horizon plane (Fig. 1).

Fig. 1 *View of section frame with seat bearers and deformation measuring points.*

With variable force F assigning, by hand lever using, in the upper part of the frame, with variable force increasing from 200 [N] it was deformation of the frame in three points measuring, on "a', "b" and "c" point. For every additional increasing force, it was frame unloading, for opportunity to measure irrecoverable deformations in these three points. Point "a" is upper horizontal plane gotten off basis bus construction, point "b" is closer up seat bearers and point "c" is placed on upper angle of side frame, where are the most values of deformations expected.

Analysis of tension-deformation condition of side frames is by computer calculations made on loading conditions which are experimentally realized. Method of Finite Elements[3,4,5] and programmer packet NISSA which are method finite elements based are for these calculation used. The way of finding these measurements places are mathematical modeling done based on frame mathematical modeling. Mathematical model is 408 elements connected in 412 nodes connected. Finite elements grid of bearers construction was of side frame number 4 calculated, from the first side frame of windbrake[1] (Fig.2).

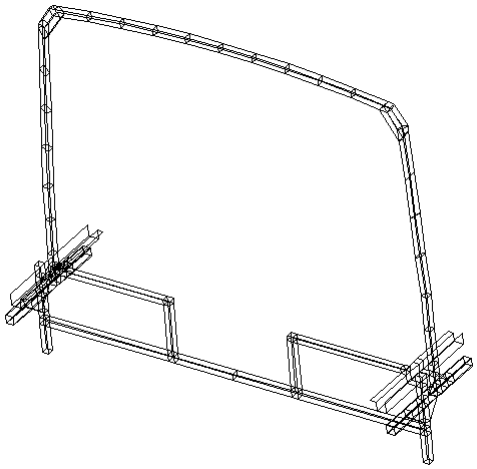

Fig. 2 *Finite elements grid of bearer's construction of side frame.*

2. Results from experimental investigations[1]

First type of seat bearers were on basis construction fixed, on horizontal plane by two screws (quality 10.9), with vertical frame same by two screws with the same quality. Table 1 shows results from investigations of side frame by first type of the seat bearers.

Depending of Force from deformations, F [N] is y axis performing. a [mm], b[mm] and c [mm] are deformation of side frame at point measuring x axis performing (Fig.2).

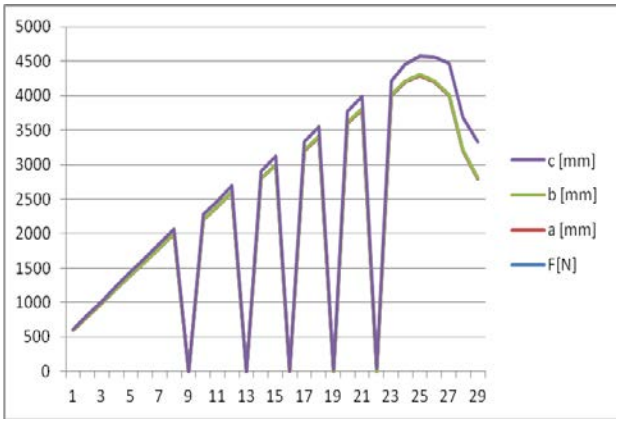

Fig.2 *Depending between loadings (forces) and deformations at measuring points of side frame with first type of seat bearers.*

Table 1: *Results from experimental investigations of side frame with first type of seat bearers.*

F[N]	a [mm]	b [mm]	c [mm]
600	0	0,1	10
800	0	0,5	20
1000	0	1	30
1200	0	1,5	40
1400	0	2	46
1600	0	2,5	51
1800	0	3	57
2000	0	3,5	64
0	0	0	0
2200	0	4	70
2400	0	4,5	77
2600	0	5	87
0	0	0	3
2800	0	5,6	97
3000	0	6,2	110
0	0	0	8
3200	0	6,9	125
3400	0	7,3	145
0	0	1	22
3600	0	7,5	165
3800	0	8	180
0	0	1,5	55
4000	0	9	200
4200	0	10	240
4300	0	11	270
4200	0	12	350
4000	0	13	450
3200	0	14	470
2800	0	15,5	520

Second type of seat bearers were by angle supercharged made on the upper part of bear, it was difference of way of fixing made on basis construction, it was metal sheet fixed (with dimensions 40x340x3 [mm]) between basis construction and seat bearers, for decreasing area pressure on the place of contact, concerning to be obtained point of vantage tension condition.

The way of fixing was the same as previous experimentally investigations.

Results are from experimental investigations of side frame with second type of seat bearers shown on Table 2.

Results from the Table 2 are graphically shown (Fig.3), concerning depending the Force from deformations, F [N] is y axis performing, and a [mm], b[mm] and c [mm] are deformation of side frame at point measuring Fig.1 performing, points measuring x axis performing.

Third type of seat bearers was the same fixing on the basis of constructive like second type, but on vertical plane of the frame it was added "Z" profile, which have been welded on upper side of the frame, but on the basis it was fixed by screws on construction of the frame.

Results from experimental investigations of side frame with third type of seat bearers shown on Table 3.

Results from the Table 3 are graphically shown (Fig.4), concerning depending the Force from deformations, F [N] is y axis performing, and a [mm], b[mm] and c [mm] are deformation of side frame at point measuring Fig.1 performing, points measuring x axis performing.

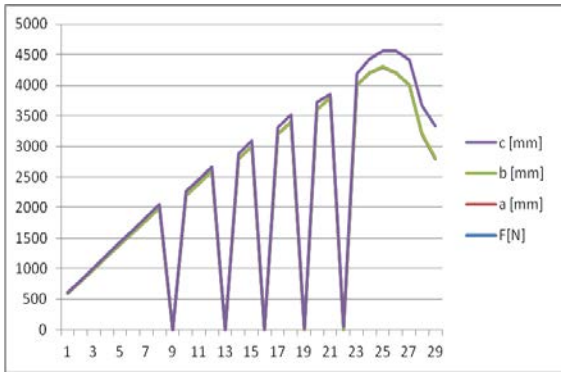

Fig.3 *Depending between loadings (forces) and deformations at measuring points of side frame with second type of seat bearers.*

Table 2: *Results from experimental investigations of side frame with second type of seat bearers.*

F[N]	a [mm]	b [mm]	c [mm]
600	0	0,1	8
800	0	0,5	16
1000	0	1	24
1200	0	1,5	30
1400	0	1,5	35
1600	0	1,5	40
1800	0	2	45
2000	0	2,5	50
0	0	0	0
2200	0	3	57
2400	0	3	63
2600	0	3	70
0	0	0	1
2800	0	3	79
3000	0	3,5	88
0	0	0	6
3200	0	4	97
3400	0	4	113
0	0	1	20
3600	0	4	120
3800	0	4,5	56
0	0	1	50
4000	0	5	182
4200	0	6	225
4300	0	6	252
4200	0	6	350
4000	0	7	405
3200	0	8	455
2800	0	8	530

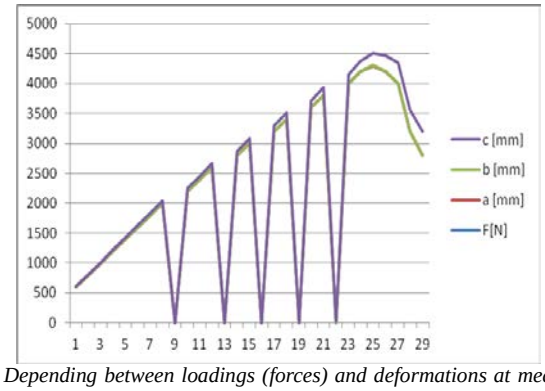

Fig.4 *Depending between loadings (forces) and deformations at measuring points of side frame with third type of seat bearers.*

Table 3: *Results from experimental investigations of side frame with third type of seat bearers.*

F[N]	a [mm]	b [mm]	c [mm]
600	0	0	6
800	0	0	12
1000	0	0	18
1200	0	0	24
1400	0	0,1	30
1600	0	0,1	34
1800	0	0,2	37
2000	0	0,2	41
0	0	0	0
2200	0	0,4	46
2400	0	0,4	53
2600	0	0,7	60
0	0	0	0
2800	0	0,7	69
3000	0	1	78
0	0	0	2
3200	0	1,2	86
3400	0	1,2	100
0	0	0	6
3600	0	1,5	111
3800	0	1,8	130
0	0	0	23
4000	0	2,5	150
4200	0	2,5	170
4300	0	3	210
4200	0	3,5	260
4000	0	4	340
3200	0	4	360
2800	0	4	400

From analysis the results from experimental investigations of side frame with first seat bearers, we can find that first durable deformations are evident on point ”b” by force of 3400 [N] made notification, and by increasing the value of force until 4300 [N] these deformations are value of 11 [mm] had.

From results (Table 2) which are from experimental investigations of side frame with second seat bearers obtained, we can find that first durable deformations on point ”b” are by force of 3400 [N] made notification, and they are with increasing the value of force to 6 [mm] increased.

For third type of seat bearers, according to the results which are on Table 3 given, durable deformations on point “b” are by value of 3800 [N] force evidenced, and they are by loading of 4300 [N] accounted 2,5 [mm].

Point “c” deformations for first type of seat bearers is from 2600 [N] beginning, and with value of 4300 [N] force they are have had 270 [mm] deformations.

Point “c” deformations for second type of seat bearers is from 2600 [N] beginning, and with value of 4300 [N] force they are have had 252 [mm] deformations.

Point “c” deformations for third type of seat bearers is from 3000 [N] beginning, and with value of 4300 [N] force they are have had 210 [mm] deformations.

The force value bigger than 4300 [N], for all three types of seat bearers, frame deformations on point “c” are increasing and by smaller values of the force F [N], what means that strain of the material is decreasing until margin of extension.

3. Conclusion

Passive safety buses, buses like transport devices for passengers, according to the EU regulations, should be on high level, distinctly for the buses construction. According ECE regulations of European Committee, R65[2], are obligatory a lot of experimental investigations made on direction of holding passenger’s safety area in case of traffic accidents. Most important element which has had an influence on the passenger’s safety area, and passenger’s safety, is construction, concerning construction of sets bear. These types of seat bearers have had most important influence of displacing the deformation, by height of side frame from bus superstructure.

Energy absorption of construction, which is corresponding breakdown and depending from mechanism of breakdown, constructive connections of nodes, and it’s proportional of diagram Force – movement (deformation). The value of energy absorption is from bear construction during the buses overturning depending from constructive solutions and whole static system.

Static system of side frame was by minor strain and strength characteristic changing of fixture seat bearers constructed and projected, like bearers elements of basis constructive.

From the results of experimental investigations of the side frame we can conclude that deformations on “b” point, for firs two types of seat bearers, were by force value of 3400 [N] beginning, but on third type of seat bearers this force is bigger for 400 [N] value and the values of deformations are smaller four times than previously two types. According deformation analysis on point “c”, for firs two types of seat bearers by maximum force of 4300 [N] loading, deformations on point “c” have had: 270 [mm] и 252 [mm] respectively value, but for third type of seat bearers these deformation has had 210 [mm] value.

Third type of seat bearers are, from constructive aspect according research in this paper, allowing raise of 60 [mm] on upper zone from side frame passengers safety area and around 8 [mm] on down part of the frame.

4. References

[1]Стојановски В. “Развој на напреден систем за оптимирање на носечки конструкции кај автобусите во однос на апсорбираната енергија при превртување”, Машински факултет - Скопје, Универзитет „Св.Кирил и Методиј„ Скопје, 2009.

[2]ECE R65, R66 regulation.

[3]Miles J.C. “The application of Finite Element Methods to Vehicle Collapse Analysis”, Ph.D Thesis, Cranified Institute of Technology, 1977.

[4]Spyrakos C.C., “Finite Element Modelling in Engineering Practice”, Algor Publishing Division, Pitsburgh, PA, 1996.

[5]Spyrakos C.C., Raftoyanis J., “Finite Element Modelling in Engineering Practice”, Algor Publishing Division, Pitsburgh, PA, 1997.