

INFLUENCE OF PROTECTED STRUCTURES ON TRACTOR SAFETY

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INTRODUCTION

Tractor protective structure, i.e. safety cabin or roll bar for protection agriculture in forestry mechanisation is protective part of vehicle with role to reduce injury possibilities for driver in unwanted roll of tractor during normal usage. Protective structure is specific for free space which characterise in inner structure blanket or in space which is restricted by line-up straight lines by edge surface structure and by any part of tractor vehicles which can be in contact with road (floor), and which can not keep tractor in certain position in the case of roll. Most technical safety devices on tractor are cabin for tractor, seat, and steering wheel, braking device, lights for road and signal lights. Safety cabin has purpose that fulfils for tractor driver: protection for atmospheric condition, protection of noise and vibration, good visibility, forced ventilation and possibility of installing air conditioning.[1]

SAFETY AND SECURITY IN TRACTOR OPERATIONAL FUNCTION

For safety driving, tractor it need that working space i.e. cabin, and represent concord completely adjusted to human body. Beside effort to made working space comfort to driver there are still missing links to advantages in constructive-technical characteristics in ergonomic design, manifested in the shape of commands etc [1].

Researching of working space is base on assuming the least of all measure for volume of working space, and entry to it; tractor drivability as the number of most necessary positions for exit from vehicle in the crash case. In testing protective structure based for ``seating place of driver entry and exit`` are specificity for construction measures in agriculture tractors which are: at least measures of driver entry, number and position of at least exit in the case of danger and at least possible volume from inner free space.

Beside this testing, for cabin mounting in tractor vehicles it is necessary that cabin content static and dynamic testing methods, as acceptance procedures as well in crash test. Static method of testing protected structure assumes testing on horizontal loads and testing on forced pressure. Researching with horizontal loads means exposure front, back and sideway surface of protected structure. Pressure testing assumes application of vertical loads with beam that is transversely mounted opposed to upper parts of protected structures.

Dynamic method of testing protective structure assumes researching by appliance of impact and pressure testing.

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Impact testing of protective structure assumes exposure front and backside of protective structure of weight impact as 2000 kg swinging arm. Pressure testing implies application of vertical loads by vertical force on testing protective structure by meaning stiff beam (with radius of 250 mm).

Safety space with inner space of tractor is define on reference plate, by assuming that safe plate is rounding horizontal with seat and steering gear in static and dynamic testing, stay normal in tractor and firm under safety structure. Safety space is in figure 1.

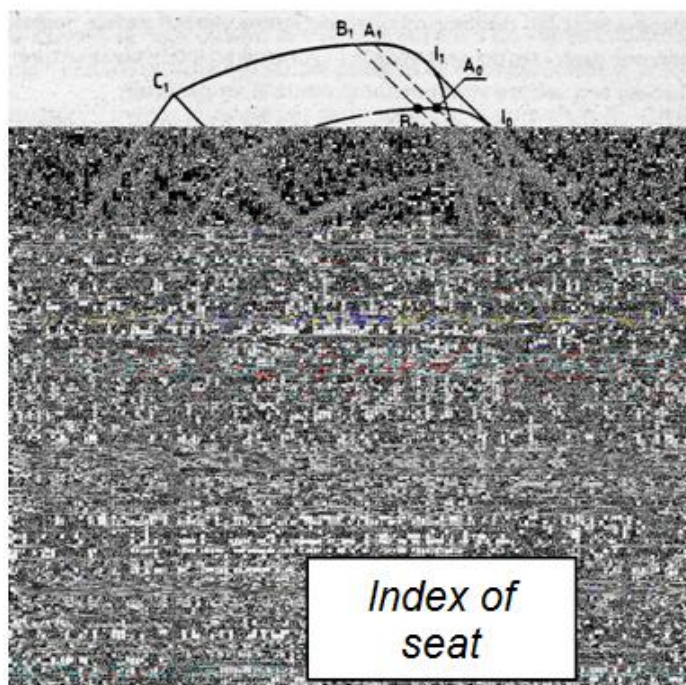


Figure 1: Safety space

INFLUENCE OF WORKING SPACE ON TRACTOR SAFETY

Working space consider al least min volume for driver space of any unmoving parts of structure which is available to driver during tractor usage for safety conducting tractor vehicle from driver's seat in any controlling direction.

Standards for testing working environment are declare for at least min measures of working space and min entry space for tractor vehicle conducting space, as well as number, position and at least min safety exits of safety structure i.e. cabin. Standard for testing ``driver's seat, entry and exit-measures`` are specifications for construction measures for agriculture tractor and consider on min measures for entry door, number and position and min measures for exit for inner free driving space.[2]

In figures 2. and 3. are declared min measures for driver entry doors.

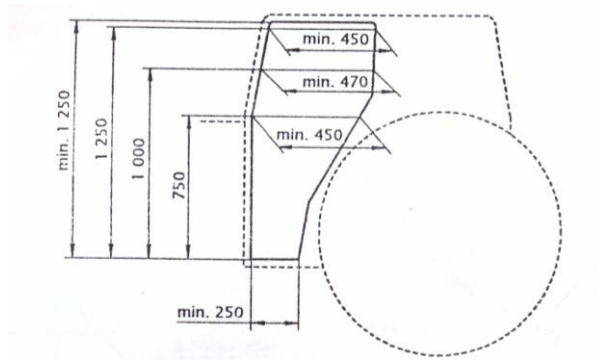


Figure 2: Declared min measures of passage way for entry door measures for driver entry[3]

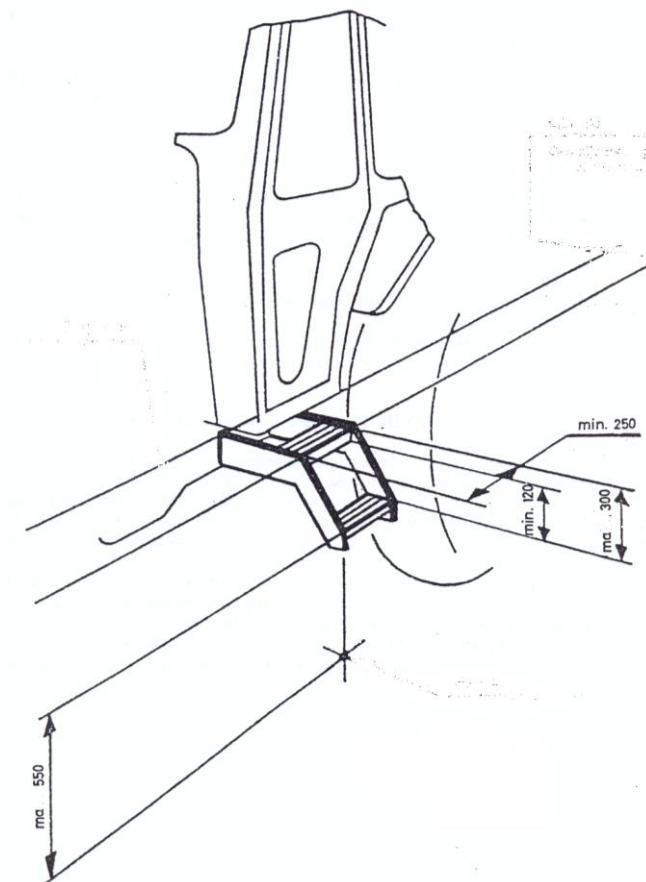


Figure 3: Declared min [3]

Min measures of cabin inner free space are defined on figures 4a and 4b. These declared measures are derived in vertical reference surface, tractor length measure and on center of steering wheel. These declared measures are defined for cabins with only one seat for driver. In case of danger there must be present three exits, each on different side of cabin. Front and back side as roof of cabin must consider as possible exit path (danger passage) ways. [3]

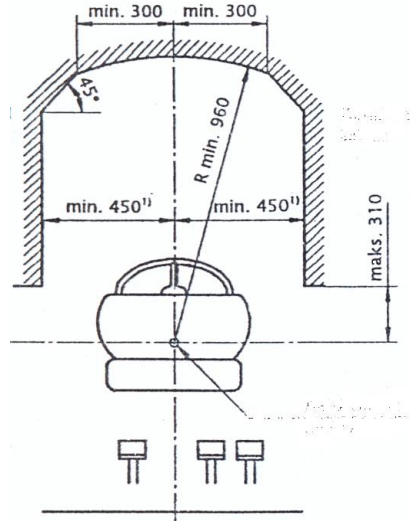


Figure 4a: Min measures of cabin inner free space [3]

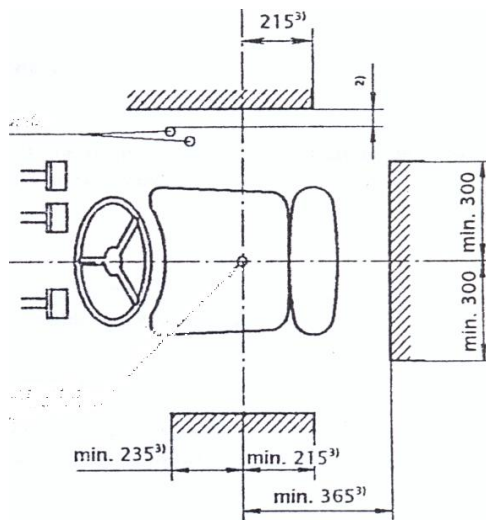


Figure 4b: Min measures of cabin free space [3]

TEST RESULTS

Industry of Engine Manufacturing in Rakovica, Belgrade, Serbia had conducted safety testing on cabins installed on tractors type R65-12BS., as well as testing on driver's seat, and testing for enter and exit on cabins by standard ISO 4252/1997. Tested safety frame is made from beam of cube cross section profile and bending steel body-lateral space (roof and mud covers). Safety structure –cabin, is joined on tractor chassis with four rubber mounting. Cabin has two side windows as middle widow and two doors. Tested cabin is shown on figure 5.



Figure 5: Tested safety cabin [2]

Measures and comparing of tested cabin are given in tables 1, 2 and 3.

Table 1: Measures on doors for entry and exit (from figures 2 u 3)

	Measures on drawing (mm)	Measured values (mm)
Min.	450	470
Min.	470	540
Min.	450	620
Min.	250	260
Max.	550	520
Min.	250	265
Max.	300	300

Table 2: Inner free space in cabin (from figure 4a)

	Measures on drawing (mm)	Measured values (mm)
Min.	300	420
Min.	300	420
Max.	310	100
R Max.	960	970

Table 3 – Inner free space in cabin (from figure 4b)

	Measures on drawing (mm)	Measured values (mm)
Min.	300	480
Min.	300	480
Min.	215	320
Min.	235	320
Min.	215	320
Min.	365	460

By analyzing results are evaluated results with geometric control of cabin safety structure R 65-12 BS and all condition state it can conclude that dimension control of inner free space is satisfying for assumed and declared standards which is legislative for tractor working safety space.

CONCLUSION

In the purpose of increasing tractor's driver safety and others conductors in traffic, there are declared legislative measures that must be accomplished during tractor manufacturing. In tractor industry, it is necessary to follow this measures as well designing and mounting safety structures by EEC demands and EEC standards. This means that tractor cabin is necessary tool for safety purposes but they need to be test during research phase. Tested by legislative standards, safety cabins could be mounted on tractors, and entry serial manufacture in tractor industry.[3]

ACKNOWLEDGMENTS

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REFERENCES

- [1] Ružić D., Časnji F., „Personalized Ventilation Concept in Mobile Mashinery Cab,,; International Journal for Vehicle Mechanics, Engines and Trasportation Systems Vol.37, Num. 1.; pg 7.-22.; UDC: 631.3:628.87; ISSN 1450-5304
- [2] - IMR Institute Report No. 230.12.
- [3] Standard ISO 4252 / 1997 year.