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agenda item 4.)

PROPOSAL FOR DRAFT AMENDMENTS TO REGULATION No. 66
(Strength of superstructure)

Transmitted by the Expert from Hungary

Note: The text reproduced below was prepared by the expert from Hungary in
order to incorporate into the Regulation the annexes concerning the structural
description of the superstructure and the body section rollover test.

Note: This document is distributed to the Experts on General Safety Provisions
only.

"Annex 4, amend to read:

"Annex 4

VIEW-POINTS TO THE STRUCTURAL DESCRIPTION OF THE SUPERSTRUCTURE

1. General principles

- 1.1. The manufacturer shall define unambiguously the superstructure (see figure 1 as an example) and shall state:
 - 1.1.1. which bays contribute to the strength and energy absorption of the superstructure
 - 1.1.2. the connecting elements between the bays which assure the torsional stiffness of the superstructure.
 - 1.1.3. the mass distribution among the nominated bays
 - 1.1.4. which elements of the superstructure are assumed as rigid parts
- 1.2. Manufacturer shall supply following information about the elements of the superstructure:
 - 1.2.1. drawings, with all the significant geometrical measurements necessary to produce the elements and to evaluate any change or alteration of the element,
 - 1.2.2. the material of the elements, referred to national, or international standards
 - 1.2.3. the joint technology between the elements (riveted, bolted, glued welded, which kind of welding, etc.)
- 1.3. Every superstructure shall have at least two bays: one in front of the centre of gravity and one behind the centre of gravity.
- 1.4. No information is required about any elements of the body-work, which are not part of the superstructure.
- 1.5. When a new variant is developed from an approved vehicle type, but no changes are made in the superstructure, its elements and their joints, the body-work of the new variant is assumed to have the same strength as the approved vehicle type.

2. Bays

- 2.1. Every bay has a centre plane (C_p) being perpendicular to the longitudinal axis of the vehicle and passing through the centre points (C_p) of the window pillars (see figure 2). The centre points are in the middle of the pillar (half of the height and half of the width). If the C_p -s of the left and right side pillars are not in one plane perpendicular to the longitudinal axis of the vehicle, the C_p of the bay is defined as the plane mid-way between the C_p -s of the two pillars
- 2.2. The width of every bay in the superstructure shall be stated. Every bay has a certain width which can be measured in the direction of the longitudinal axis of the vehicle. The width of a bay is defined as the distance between two planes perpendicular to the longitudinal axis

of the vehicle. There are two limits which define the width of a bay; depending on the window (door) arrangement, and the shape and construction of the window (or door) pillars (see as examples figure 2)

- 2.2.1. The maximum width of a bay is defined by the width of the two neighbouring window (or door) frames (see figure 2)

$$(W_j)_{\max} = 1/2 (a + b)$$

Equation 1

where "a" is the length of the window (or door) frame behind the j^{th} pillar and "b" is the same in front of it, measured in the level of C_p -s of the pillars. The width of a bay must not exceed the value of equation 1 on each sides of the vehicle.

If the pillars on the two-side are not in one perpendicular plane, or the two-side window frames have different width, the smaller value determines the maximum width of the bay (The width of the bay must not exceed on any side the value of equation 1)

- 2.2.2. The minimum width of a bay shall be determined so that the whole pillar on each side of the vehicle (including its inclination, corner radii, etc.) shall be inside the bay

- 2.3. The distance between two bays shall be defined as the distance between the C_p -s of the two bays. The distance between a bay and the centre of gravity shall be defined as the distance between the C_p of the bay and the parallel plane containing the centre of gravity.

3. Connecting structures between the bays.

- 3.1. The connecting structures between the bays shall be clearly defined. These elements fall into two categories:

- 3.1.1. the connecting structures which form part of the superstructure must be given by the manufacturer. These will be,

- 3.1.1.1 sidewalls, roof structure, floor structure which connect several bays,

- 3.1.1.2 structures which reinforce one or more bays; pedestals, boxes under seats, wheel arches, seats connecting sidewall to floor structure, kitchen, wardrobe and toilet structures, for example

- 3.1.2. the additional structures which run between bays (ventilation ducts, hand luggage boxes, heating ducts, rails for seat anchorage, for example.) but do not contribute to the structural strength of the vehicle. Information about these structures may be given by the manufacturer

4. Mass distribution

- 4.1. The manufacturer shall clearly define the distribution of the [unladen] mass of the vehicle (M_k) among the bays nominated in the superstructure. This mass distribution shall express the ratios of the energy absorbing capability and load bearing capacity of the bays. The further requirements have to be met when distributing the mass:

- 4.1.1. the sum of the masses attributed to each bay (m_j) shall be related to the declared total [unladen] mass:

$$\sum_{j=1}^n (m_j) \geq M_k$$

Equation 2

where m_j = the mass attributed to the j^{th} bay
 n = number of bays in the superstructure

- 4.1.2. the centre of gravity of the distributed masses shall be in the same position as the centre of gravity of the vehicle:

$$\sum_{j=1}^n (m_j l_j) = 0$$

Equation 3

where l_j = the distance of the j^{th} bay from the centre of gravity of the vehicle (see paragraph 2.3.).

l_j is positive if the bay is in front of the centre of gravity, and negative if it is behind the centre of gravity

- 4.2. The mass " m_j " of each bay of the superstructure shall be defined by the manufacturer, by considering the following requirements:

- 4.2.1. the mass of the components of the " j^{th} " bay shall be related to its mass " m_j " by:

$$\sum_{k=1}^s m_{jk} \geq m_j$$

Equation 4

where m_{jk} = the mass of each component of the bay
 s = number of individual masses in the bay

- 4.2.2. the centre of gravity of the component masses of a bay shall have the same position inside the bay (in the cross section) as the vehicle's centre of gravity (see figure 3)

$$\sum_{k=1}^s m_{jk} y_k \equiv \sum_{l=1}^s m_{jk} z_k \equiv 0$$

Equation 5

where y_k = the distance of the k^{th} mass component of the bay from the axis "Z" of the cross-section (see figure 3)

z_k = the distance of the k^{th} mass component of the bay from the axis "Y" of the cross-section

The distances " y_k " and " z_k " from their respective axes will be either positive or negative depending on which side of the axes lays the centre of gravity of each individual component.

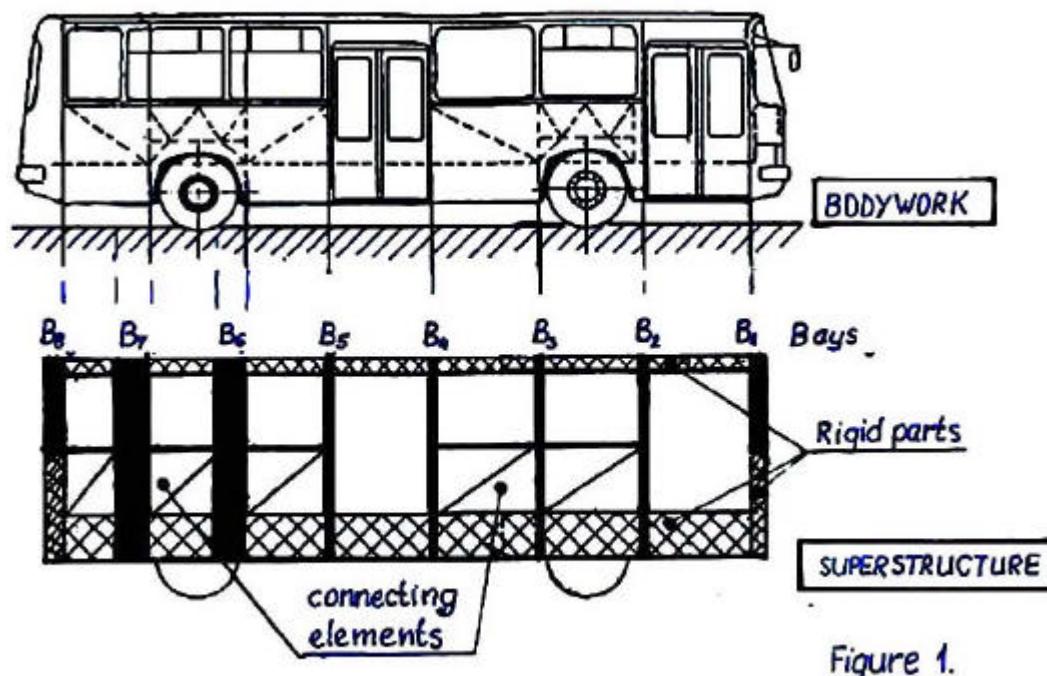


Figure 1.

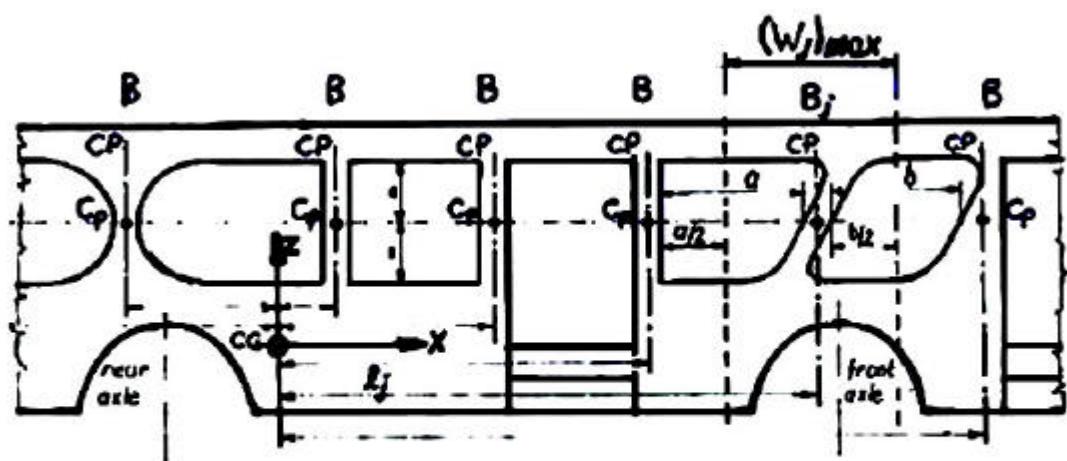


Figure 2.

Cross section of Bay "Bj"

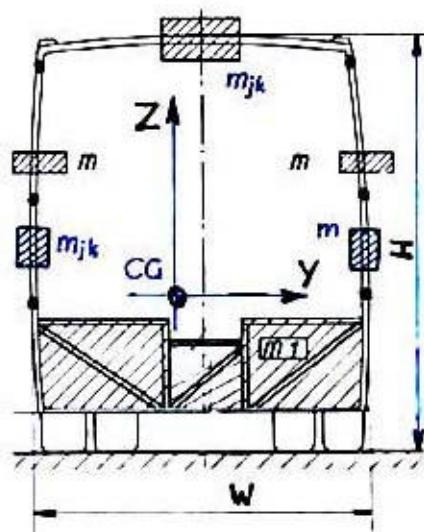


Figure 3.

Annex 6, amend to read:

"Annex 6

ROLLOVER TEST WITH BODY SECTIONS

1. Additional data and information
If the manufacturer chooses this method of testings, the following information shall be given to the technical service in addition to the data, information and drawings listed in paragraph 3. of the main text of this Regulation:
 - 1.1. Drawings of the body sections to be tested
 - 1.2. Verification of the validity of equation 2, equation 3, equation 4 and equation 5 given in annex 4, paragraph 4.1. upon completion of successful body section rollover tests
2. The tilting bench
The tilting bench shall meet the requirements given in annex 5, paragraph 1.
3. Preparation of body sections
 - 3.1. The number of body sections to be tested shall be determined by the following rules:
 - 3.1.1. all the different bay configurations which are part of the superstructure shall be tested in at least one body section
 - 3.1.2. every body section shall have at least two bays
 - 3.1.3. the mass ratio of the bays combined in an artificial body section must not exceed the value 2
 - 3.1.4. the whole residual space shall be well represented in the body sections including the special combinations of the residual space and body-work, too.
 - 3.1.5. the whole roof structure shall be well represented in the body sections if there are local specialities, like changing height, air condition installation, gas tanks, luggage carrier, etc.
 - 3.2. The bays of the body section shall be exactly the same in their shape, geometry, material, joints as the bays which they represent in the superstructure of the actual vehicle.
 - 3.3. The connecting structures between bays shall represent the manufacturer's description of the superstructure (see annex 4 paragraph 3.) and the following rules shall be considered:
 - 3.3.1. in the case of original body sections the connecting structures (see paragraph 3.1. in annex 4) shall be the same as that of the actual vehicle
 - 3.3.2. in the case of an artificial body section the connecting structures shall be equivalent (in terms of strength and stiffness) to those of the actual vehicle superstructure.
 - 3.3.3. those rigid elements which are not part of the superstructure but which can intrude into the residual space after deformation, shall be installed into the body sections.

- 3.3.4 the mass of the connecting structures shall be considered in the mass distribution both between the bays and inside the bays.
- 3.4. The body sections shall be positioned on the tilting platform, using supports, so that their CG position and axis of rotation is the same as that of the complete vehicle. The supports shall meet the following requirements:
- 3.4.1 they shall be fixed to the body section in such a way that they do not provide reinforcement to or additional load on the body section
- 3.4.2 they must not suffer deflection or deformation during the tilting and rollover process which could change the path of the body section motion.
- 3.4.3 their mass shall be included considered in the mass distribution and CG position of the body section
- 3.5. The distribution of mass in the body section shall be carried out with the following considerations:
- 3.5.1. the whole body section (bays, connecting structures, additional structural elements, supports) shall be included when checking the validity of equation 4 and 5 in annex 4 paragraph 4.2.
- 3.5.2. the component masses of the bays (see paragraph 4.2.2. and figure 4 in annex 5) shall be placed and fixed to the body section in such a way that they do not cause reinforcement, additional load, or limitation of the deformation.
4. Test procedure.
The test procedure shall be the same as described in paragraph 3. of annex 5 for a complete vehicle.
5. Evaluation of the tests.
- 5.1. The vehicle type shall be approved if all the required body sections pass the rollover test and equations 2 and 3 in paragraph 4.1. of annex 4 are fulfilled.
- 5.2. If one of the body sections fails the test, the vehicle type shall not be approved.
- 5.3. If a body section passes the rollover test, all the bays which form that body section are considered to have passed the rollover test, and these results can be quoted in future requests for approval, provided that the component bays have the same mass ratio in the subsequent superstructure .
- 5.4. If a body section produces fails the rollover test, then all the bays being part of it are considered to have failed the test even if the residual space is invaded in only one of the bays.
6. Documentation of body section rollover tests
The test report shall contain all the necessary data, information (pictures, records, drawings, measured values, etc.) to show:
- 6.1. that the tests were carried out according to this annex.

- 6.2. whether the requirements stated in paragraph 5.1.1. and 5.1.2. in the main text of this Regulation are met
 - 6.3. the individual evaluation of the body sections and their bays
 - 6.4. all the data and information necessary for the identification of the vehicle type, its superstructure, the tested body sections, the tests themselves and the personnel responsible for the tests and their evaluation."
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