

Madrid meeting
WD.3.

TYPICAL BUS FRONTAL COLLISIONS

Presented by Hungary

GENERAL REMARK

Based on the detailed accident analysis presented on the first Madrid meeting (2003, September) [9] [14] [15] [16]* and considering some other technical papers [2] [3] [12] [17]* the frontal collisions of buses may be categorized to determine some typical collision types. These typical collisions could help us, when determining the main risks for the bus occupants (passengers, driver, crew) and the important, sensitive systems (brake, steering, electrical, fuel) being differently endangered in the different typical collisions.

TYPES OF COLLISIONS

One possible categorization of the bus frontal collisions – which seems to be general enough – is the following:

- Collision with wall-like object
 - full frontal collision
 - offset collision on the side of driver compartment (DC)
 - offset collision on the service door side
 - collision on the DC side under angle
 - collision on service door side under angle
- Collision with head-plate object (HPO)
 - full-width collision with HPO
 - collision on DC side with HPO
 - collision on service door side with HPO
- Collision with pole-like object
- Underrun-like collision.

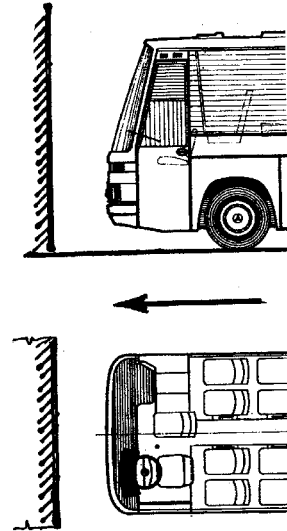
1. Collision with wall-like object

The impacted object is large, extended (both in height and width), the impacted surface is equal or larger than bus front wall so it does not cause itself any limitation in the extension of the collision. It means that the impacted surface is plane-like (no local intrusions or extrusions), its rigidity is quasi-evenly distributed and this rigidity is at least in the same order as that of the front wall of the bus. The relation (position) of the bus front wall to the wall-like object could be different (full or partial overlapping) Wall-like object could be: concrete or brick walls of buildings, front or rear walls of heavy vehicles, etc. The following subcategories may be defined.

* The references are listed in WD.1.

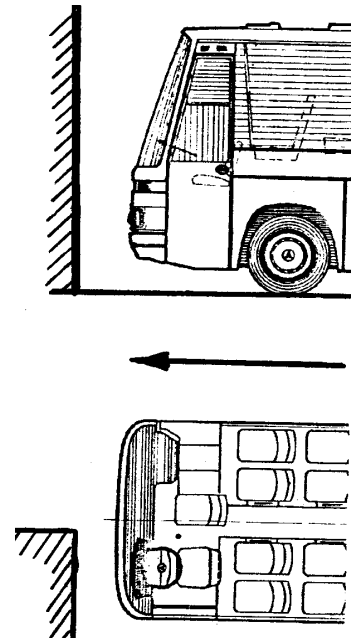
Full frontal collision

The full front wall of the bus is hitting the object, the impact speed (therefore the impact force) is closely perpendicular to the impacted wall-like object, the structural deformation (damage) of the bus front wall is closely evenly distributed



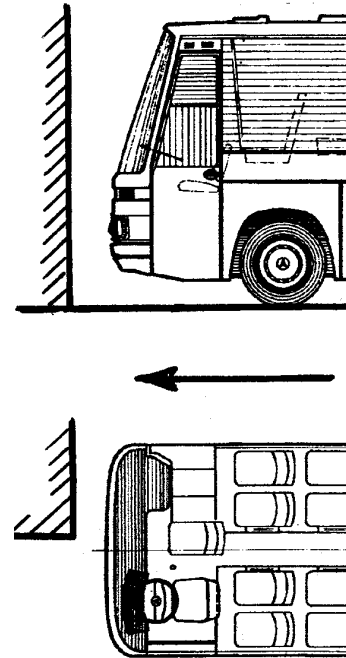
1.2. Offset collision on the driver compartment (DC) side

The wall-like object hits only a certain part of the bus front wall. The measure of the offset could be expressed as % of the width of the front wall. The damage is concentrated to the hit part of the front wall, it is partial. The impact speed (and force) is closely perpendicular to the impacted wall like object.



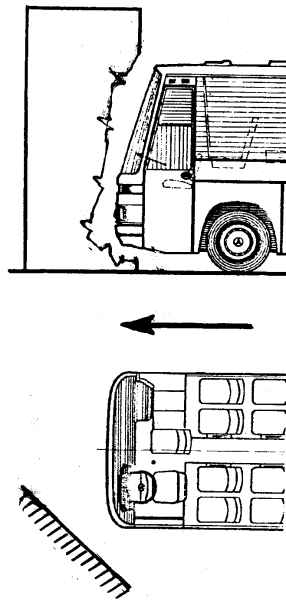
1.3. Offset collision on the service door side

Similar (symmetrical) arrangement to the situation described in para 1.2., but on the other side



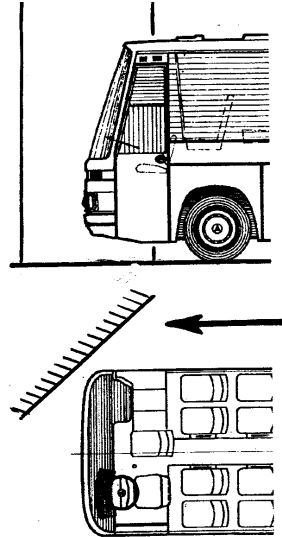
1.4. Collision on the DC side under angle

The bus hits the wall-like object under a certain angle (not perpendicularly) so the front wall corner gets the impact force. The front wall deformation (damage) is concentrated on the DC, it is partial. The result apparently could be similar to deformation described in para. 1.2. but the impact process is different.



1.5. Collision on the service door side under angle

Similar (symmetrical) arrangement to the situation described in para. 1.4.

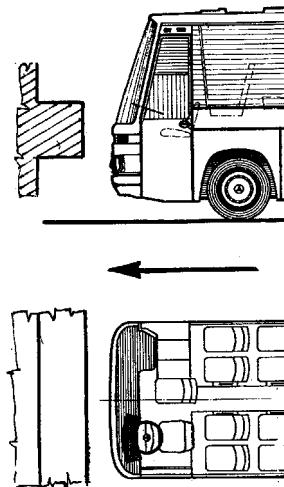


2. Collision with head-plate objects, (HPO)

This type of object is also bulky, massive, representing a considerable impact force. It has a closely vertical active face with a certain (limited) height. This height and height position could be different, the most relevant objects are located under the wind screen and above the floor level in the front part of the bus. The deformation of the front wall caused by this type objects is local, partial. This impact hits a relatively “soft” part of the front wall. These type of objects in the practice: special building construction, parts rear wall of heavy trucks, trailers, lorry and truck platforms, etc.

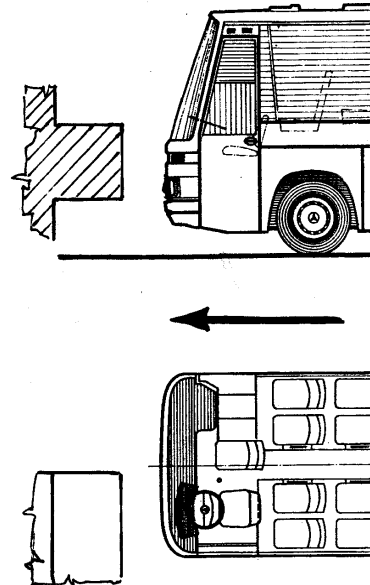
2.1. Full- width collision with HPO

The HPO horizontally covers the full width of the bus front wall, so the deformation zone is extended to the full width of the front wall.



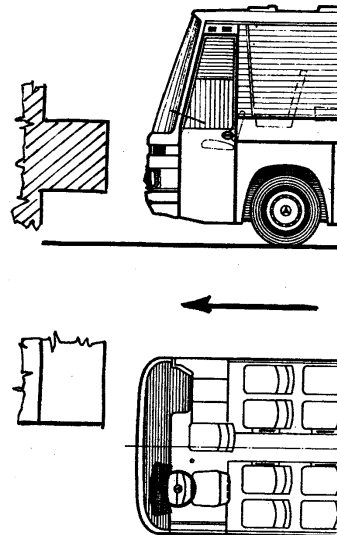
2.2. Collision on the DC side with HPO

The impact force may act parallel to the longitudinal central plane of the bus or under a certain angle to that. The deformation (damage) is local, partial, concentrated mainly on the DC and the corner of front wall.



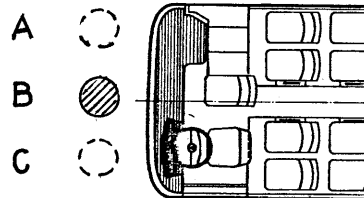
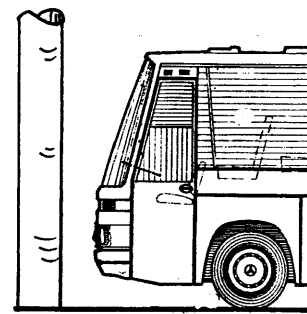
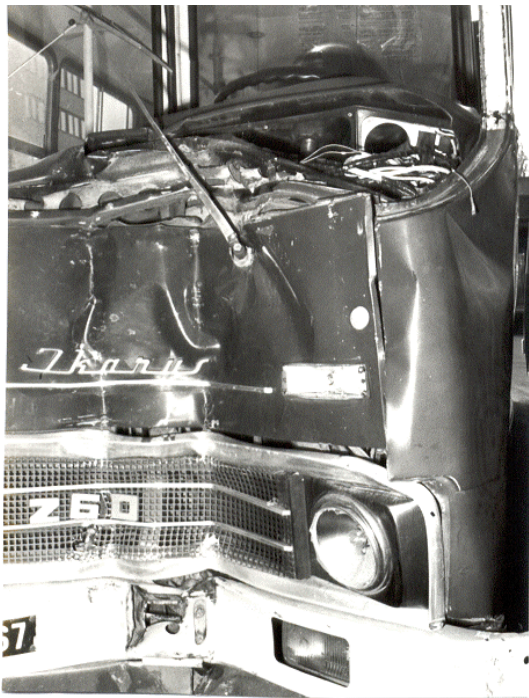
2.3. Collision on the service door side with HPO

Similar (symmetrical) situation as it is described in para. 2.2. but on the other side



3. Collision with pole-like objects (PLO)

The pole-like object is a rigid, strong vertical object, higher than the front wall of the bus having the width (diameter) in the range of 150-300 mm. There are three characteristic hitting position: between the longitudinal members of the underframe structure (central position "B") and side positions either on the DC (position "C") or on the service door side (position "A"). The deformation of the front wall caused by PLO is a special, deep intrusion, so it is local, partial one. These type of objects in the practice: three, concrete or steel pillars, pylons, poles supporting electric or telephone cables, etc.



4. Underrun-like collisions

The hitting object is smaller, lower than in the previous cases, but it represents a considerable impact force and energy. The impacting surface is limited in width and height, the important situation is when it is on the DC side. The impact force may act parallel to the longitudinal central plane of the bus or under a certain angle to that. (Sometimes the symmetrical situation on the service door side should be also considered) In this case the main impact is concentrated in the bumper zone, the damage is local, mainly under or in the floor level of the DC.

