

STUDY REGARDING MASS REPARTITION TO ROAD VEHICLE WITH MULTIPLE DESTINATIONS

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ABSTRACT

This paper presents a study regarding to distribution of mass road vehicles for multiple destination: for freight transport and people transport. Category of this road vehicle is N1 with the maximum mass allowance 3500 kg. Main producers of this categories of road vehicle achieve common platforms, subsequently has transformed to the final type destination. The distribution of mass road vehicles on the axes is different because the mass center of freight is different after transformation. Some aspects of this new situation which appear to modification of freight are presented in the case of vehicle from category N1.

1. INTRODUCTION

The study realized in this paper is the road freight vehicle type "lightly truck" (figure 1) with next principal parameters:

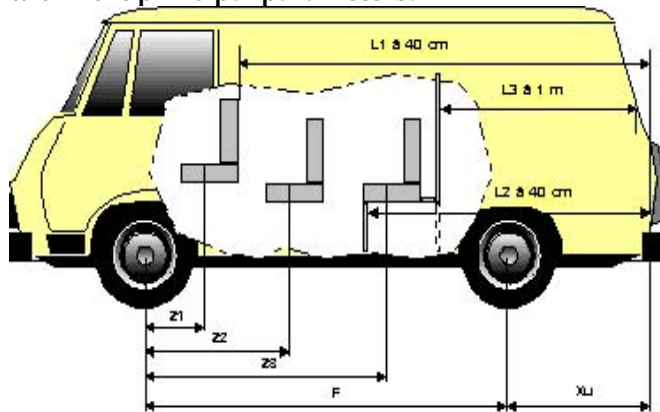


Figure 1 Parameters of road vehicle

L1-measured in meter: The length of space charge before transformation (this data can be measured or can be take from producers of road vehicle);

L2-measured in meter: The length of space charge measured to +40 centimeter height regard to floor vehicle;

L3- measured in meter: The length of space charge measured to +1 meter height regard to floor vehicle;

F-measured in meter (wheel base)

Xu-rear overhang

Z1-measured in meter: distance from mass center of front seats and rear axle

Z2- measured in meter: distance from mass center second line of seats and rear axes

Z2- measured in meter: distance from mass center third line of seats and rear axle

Yc- measured in meter: distance from mass center of load and rear axle

FZ(1,2 and 3)- measured in meter: distance from mass center of seats and rear axes

PTAC-measured in kilo: admissible maximum mass (for category N1 is 3500kg)

PV- measured in kilo: own vehicle mass (without driver, a fuel tank is 90% full)

PV1- measured in kilo: own vehicle mass to front axes E1

PV2- measured in kilo: own vehicle mass to front axes E2

POM- measured in kilo: own vehicle mass in driving conditions (European Directive CE 98/14

$POM = PV + 75 \cdot 0,1M$ (M-mass of 100 % fuel from fuel tank)

CM- measured in kilo: mass of load

CMAR- measured in kilo: load distribution on the rear axes

CMAV- measured in kilo: load distribution on the front axes

E1- measured in kilo: maximum load to front axes

E2- measured in kilo: maximum load to rear axes

C.U.- measured in kilo: real load (=PTAC)

N-number of the seats including driver seat

2. THE STUDY

2.1. Condition imposed

- For vehicle with admissible maximum mass (for category N1 is 3500kg), and the seat number is $N \leq 7$ and the body structure is tip BB VAN , after classification from European Directive 98/14/CE (for vehicle with multiple destination, people transport with luggage or freight transport in the same compartment) it is necessary to verify the ratio of luggage mass and people mass following relation:

$$PTAC - (POM + (N1) \times 68) > (N1) \times 68$$

- For other cases if the people mass including the driver is less with 60% from real load C.U. then:

$$75 \times N = \dots < (PTAC - PV) \times 0,6$$

- For the cases if the vehicle is with two line of seats, PTAC must be more 2400 kg

2.2 Dimensional Checking and design description

- L3 must be more or equal then 1meter
- If the vehicle has just one line of seats L2 must be more or equal then $0,5 \times L1 + 0,3$
- If the vehicle has two line of seats L2 must be more or equal then $0,4 \times L1$
- If Yc value is negative it is necessary a certification from producer to accept this value and it must be included into condition the maximum load on front axes
- It is forbidden to separated the first line of seats with the second line of seats
- The space for passengers must be separated from the space of freight with rigid closure with a resistance of 800KN/m^3
- If the vehicle has more than two line of seats is necessary to assembled the stuck window

3. MASS DISTRIBUTION ON AXES

3.1. Driver and passengers

1. first line of seats

Driver mass and passengers: $P1 = 75 \text{ kg} \times$

passengers number

$P1 = \dots \text{kg}$

$Z1 = \dots \text{m}$

$F - Z1 = \dots \text{m}$

$P1AV = (P1 \times (F - Z1)) / F = \dots \text{kg}$

$P1AR = (P1 \times Z1) / F = \dots \text{kg}$

2. second line of seats

mass passengers: $P2 = 75 \text{ kg} \times$ passengers

number

$P2 = \dots \text{kg}$

$Z2 = \dots \text{m}$

$F - Z2 = \dots \text{m}$

$P2AV = (P2 \times (F - Z2)) / F = \dots \text{kg}$

$P2AR = (P2 \times Z2) / F = \dots \text{kg}$

3.3. Calculation with passengers

Vehicle mass

Driver and passengers AV (first line of seats)

Passengers on second line of seats

Passengers on third line of seats

Load

Maximum load

Maximum authorized load

3.4. Calculation without passengers

Vehicle mass

Driver (1)

Load

Maximum load

Maximum authorized load

3. third line of seats (optional)

mass passengers: $P3 = 75 \text{ kg} \times$ passengers

number

$P3 = \dots \text{kg}$

$Z3 = \dots \text{m}$

$F - Z3 = \dots \text{m}$

$P3AV = (P3 \times (F - Z3)) / F = \dots \text{kg}$

$P3AR = \dots \text{kg}$

$P3AR = (P3 \times Z3) / F = \dots \text{kg}$

3.2. Load mass

$CM = PTAC - (PV + P1 + P2 + P3)$

$CM = \dots \text{kg}$

$CMAV = (CM \times Yc) / F = \dots \text{kg}$

$CMAR = (CM \times (F - Yc)) / F = \dots \text{kg}$

Total	Front	Rear
PV=	PV1	PV2
P1=	P1AV=	P1AR=
P2=	P2AV=	P2AR=
P3=	P3AV=	P3AR=
CM1=	CM1AV=	CM1AR=
PTC1=	E1=	E2=
PTAC=		

PV=	PV1	PV2
P1= 75kg	P1AV=	P1AR=
CM2=	CM2AV=	CM2AR=
PTC1=	E1=	E2=
PTAC=		

Calculation condition:

1. CMAR= maximum load on axes: E2-PV2-P1AR

Calculation: $CM = (CMAR \times F) / (F - Y_c)$

$CM = PTAC - PV - 75 \text{ kg}$

E1 must be more of minimum mass authorized

$CM_{AV} > \text{minimum mass authorized} - PV1 - P1AV$

If the condition is not achieved:

$CM_{AV} = \text{minimum mass authorized} - PV1 - P1AV$

$CM = (CM_{AV} \times F) / Y_c$

4. ANALISES, APROCHES

For the example of repartition of mass it was made a calculation for a vehicle CITROEN JUMPER L3H2 with extra four seats.

1	Categoria	AUTOUTILITARA N1		PTAC=3500 kg (maximum authorized mass)		
2	Caroseria	BB furgon		E1 max=1850 kg		
3	Marca	CITROEN		E2 max=2000 kg		
4	Tipul Varianta	Y/CBMFC/JUMPER		F=4,078 m		
5	Numarul de omologare Anul fabricatiei	BF15231811U37E4 / 2007		L1,L2,L3=3.68,2.79,2.655 m		
6	Numarul de identificare	VF7YCBMFC11137366		Xu=0.959 mm		
7	Masele (Kg)	Proprie	2050	Totala max. autorizata	3500	Z1=0.95 m
		Sarcina utilia max. autoriz.	1450	Sarcina pe cirigul de remorcare	100	Z2=1.755 m
	Maxima autorizata pe axe	Fata	1850	Mijloc		Yc=(L2/2)-Xu=0.436 m
		Spate	2000	Pe rola de senia		PVconst=2050 kg
	Remorabila cu disp. de frinara	2500	Remorabila fara disp. de frinara	750	E1 const=1290 kg	
					E2 const=760	
					Cab mass=145 kg	

Figure 2 - Example before transformation

E1 cabine=38 kg

E2 cabine=107 kg

PV transf=PVconst+cabine=2195 kg

E1 transf=E1const+E1cabine=1328 kg

E2 transf=E2const+E2cabine=867 kg

Tank fuel mass=70 litres

POM = PVtransf +75 – (0,1*70*0.9)=2263.7 kg with petrol

N=5 passengers number

Condition

1. $PTAC \leq 3500 \text{ kg}$ and maximum of number passengers is 7

$PTAC - (POM + (N-1) * 68) > (N-1) * 68$

The results :964,3kg>272kg

Repartition of load

Driver and passengers

*P1=75kg*3 passengers (including the driver)

* P1AV= [P1 * (F-Z1)] / F

* P1AR= [P1 * Z1] / F

*P2= 75 * 3 passagers

*P2 AV= [P2 * (F-Z2)] / F

*P2 AR= [P2 * Z2] / F

P3= 75 0 passagers

*P3 AV= [P3 * (F-Z2)] / F

*P3 AR= [P2 * Z2] / F

PTC1 max. laod	3500
PTAC	3500
E1=	1670,63
E1max	1850
E2=	1829,37
E2max	2080

The results:

P1=	150
P1AV=	115,06
P1AR=	34,94
P2=	225
P2AV=	128,17
P2AR=	96,83
P3=	0
P3AV=	0
P3AR=	0

Driver and load

$$* CM = PTAC -$$

$$(PV + P1 + P2 + P3)$$

$$* CMAV = [CM * Yc] / F$$

$$* CMAR = [CM * (F - Yc)] / F$$

The results:

$$CM = 930$$

$$CMAV = 99,4$$

$$CMAR = 830,6$$

Calculation with passenger

$$* PTC1 = Pvtransf + P1 + P2 + P3 + CM$$

$$* E1 = E1transf + P1AV + P2AV + P3AV + CM1AV$$

$$* E2 = E2transf + P1AR + P2AR + P3AR + CM1AR$$

5. CONCLUSIONS

The results obtained can lead to the following conclusion:

- ✚ it is necessary to make a repartition of mass to vehicle with multiple destinations for safety driving condition;
- ✚ the method can be used for the increased the degree of safety for the vehicle with multiple destination from N1 category;
- ✚ some aspects can be used to vehicle with special destination (ambulance, etc.)

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