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# ASSUMED VERSUS ACTUAL WEIGHTS OF VEHICLE PASSENGERS

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16. Abstract

Passenger weight is an important parameter in road transportation because it can significantly affect the operational weight of the vehicle. In turn, the operational weight of the vehicle has important consequences for the safe structural design of vehicle components (such as suspension, wheels, and tires), and for the detrimental impact of vehicle operations on pavement longevity. These considerations are especially important for mass-transit vehicles (i.e., those transporting a substantial number of passengers at once) such as buses. Importantly, the weight of the average American adult has increased substantially during the past 50 years, but the assumed average passenger weight has not always been adjusted accordingly. This brief report analyzes the discrepancy between the current actual and assumed passenger weights, with the primary focus on buses.

The analysis indicates that the current average weight of an American adult is 180 lb, while the Federal Transit Administration (FTA) regulations assume an average weight of 150 lb. Consequently, it is recommended that the FTA consider adopting 180 lb as the appropriate assumed weight.

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# Introduction

Passenger weight is an important parameter in road transportation because it can significantly affect the operational weight of the vehicle. In turn, the operational weight of the vehicle has important consequences for the safe structural design of vehicle components (such as suspension, wheels, and tires), and for the detrimental impact of vehicle operations on pavement longevity. These considerations are especially important for mass-transit vehicles (i.e., those transporting a substantial number of passengers at once) such as buses. Importantly, the weight of the average American adult has increased substantially during the past 50 years, but the assumed average passenger weight has not always been adjusted accordingly.

This brief report analyzes the discrepancy between the current actual and assumed passenger weights, with the primary focus on buses. The underlying assumption was that if an assumed weight was used in a regulation, it was used because passenger weight was an important factor within that regulation. In other words, no attempt was made to quantify the impact of any discrepancies between actual and assumed weights on passenger safety or pavement maintenance.

## Actual weight of adults in the United States

Table 1 shows the mean weights of American males and females from three nationwide surveys performed by the Centers for Disease Control and Prevention (CDC): 1960-1962 (Ogden, Fryar, Carroll, and Flegal, 2004), 2003-2006 (McDowell, Fryar, Ogden, and Flegal, 2008), and 2007-2010 (Fryar, Gu and Ogden, 2012). The increase from the 1960-1962 to the 2007-2010 survey amounted to 29.2 lb for males and 26.0 lb for females.[*] Another way to illustrate these changes is to point out that the average female now weighs about the same as the average male did 50 years ago.

Table 1
Mean weight of adults by gender, 1960-2010
(applicable age ranges are listed in parentheses).

| Year | Males | Females |
|---|---|---|
| 1960-1962 (20-74 years) | 166.3 lb | 140.2 lb |
| 2003-2006 (20 years and over) | 194.7 lb | 164.7 lb |
| 2007-2010 (20 years and over) | 195.5 lb | 166.2 lb |

According to the latest census, the U.S. population 20 years of age and older included 51.6% females and 48.4% males (U.S. Census, 2011). If the latest weight data in Table 1 (for 2007-2010) are adjusted to account for the relative proportions of males versus females in the population, the calculated average weight of an adult in the U.S. is 180.4 lb.

[*] Given that the 1960-1962 data did not include people over 74 years of age, the listed average weights slightly *overestimate* the actual average weights. This is the case because the average weight of people over 74 years is lower than the average weight of all adults (Ogden, Fryar, Carroll, and Flegal, 2004). Consequently, the calculated changes slightly *underestimate* the actual changes.

## Assumed weight of bus passengers

In recognition of the increased weight of American adults, in March 2011, the Federal Transit Administration (FTA) issued a proposed rulemaking that would increase the assumed average weight of a passenger (for calculating fully loaded bus weight) from the current 150 lb to 175 lb (FTA, 2011). However, in response to legislation directing the FTA to establish new pass/fail standards that require a more comprehensive review of its overall bus-testing program, this proposed rulemaking was withdrawn in December 2012 (FTA, 2012). The existing 150-lb value was then reaffirmed in the new pass/fail standard for buses issued in August 2016 (FTA, 2016).[†]

The proposed 2011 rulemaking (FTA, 2011) cited the weight data for 2003-2006 listed in Table 1. However, as shown in Table 1, the 2007-2010 survey showed that the weights of both males and females increased even further since the 2003-2006 survey.

## Assumed weight of passengers in other transportation modes

Table 2 lists the assumed passenger weights by the National Highway Traffic Safety Administration (FHWA), Federal Aviation Administration (FAA), and U.S. Coast Guard (2010).

Table 2
Assumed mean weights of persons by different transportation modes.

| Transportation mode | | Males | Females | Combined |
|---|---|---|---|---|
| Road [1] (NHTSA, 2015) | | | | 150 lb |
| Air [2] (FAA, 2005) | Summer [3] | 200 lb | 179 lb | 190 lb |
| | Winter [4] | 205 lb | 184 lb | 195 lb |
| Water [5] (U.S. Coast Guard, 2010) | | | | 185 lb |

[1] All ages; multiplied by number of seating positions to determine passenger load.
[2] Adults only.
[3] Includes 5 lb for clothing and 16 lb for personal items and carry-on bags.
[4] Includes 10 lb for clothing and 16 lb for personal items and carry-on bags.
[5] All ages; used to determine maximum passenger load for vessels.

[†] The proposed rulemaking that was withdrawn (FTA, 2011; 2012), in addition to recommending increasing the average passenger weight, also recommended increasing the amount of 'free floor space' for standing passengers in buses from 1.5 $ft^2$ to 1.75 $ft^2$; the new standard retained the current value of 1.5 $ft^2$ (FTA, 2016).

## Weight of adults versus weight of children

The weights considered in this report were for adults 20 years of age or older. Obviously, including children in the calculations would reduce the average weight. However, given that it is possible (and highly likely under certain circumstances) for a bus to transport adults exclusively, it is reasonable that the assumed average weight be based on adults only.

## Conclusions

To be effective (as well as accurate), assumed passenger weights should reflect reality. Therefore, if the assumed passenger weight in buses is deemed important enough to be specified in regulations, the regulations should be updated to be consistent with the actual average weight of the current U.S. population. Currently, the FTA assumes average passenger weight to be 150 lb, compared with the actual average weight of 180 lb for an American adult. Indeed, the actual average female weight (the lighter of the two genders) is currently 11% higher than the assumed average weight for both genders combined. Consequently, it is recommended that the FTA consider adopting 180 lb as the appropriate assumed passenger weight. This recommendation is conservative because it only reflects the average weight of an American adult without any clothing (which the FAA estimates to average 5 lb in summer and 10 lb in winter).

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