Geometrical prerequisites for a third ISOFIX type anchorage

Background

In general, child restraint systems installed into vehicles by means of the ISOFIX anchorages (positioned in the seat bight) require additional means of attachment to the vehicle. Current technical solutions include support legs and top tethers (to prevent forward pitch), and floor tethers and rebound bars (to prevent rearward pitch). Among these only the top tether is described in a standard (ref.). However, the top tether is not a feasible solution for rear facing child restraint systems, among which the support leg is the most prevalent technical solution. The support leg is also used in many forward facing applications.

Currently, the support legs rest on the vehicle floor without being attached to it, thus only taking the forward oriented loads (which are the main loads in frontal impact). For this reason, this design is in most cases complemented by a rebound bar or floor tethers to prevent rearward pitch at rebound or at rear impact. The resulting installation procedure may be complicated for the average end user, and may result in misuse of the child restraint system. Also, due to the various designs of vehicles and child restraints, there may be some incompatible combinations. This incompatibility may be of geometrical or load nature.

In order to minimize misuse and to ensure compatibility, further work is needed to standardize a third ISOFIX attachment between child restraint systems and vehicles. A standardized attachment would ease the work for improved child safety both from a child restraint system manufacturer and a vehicle manufacturer point of view. Ideally, this attachment could be utilized by both rearward and forward facing child restraints for children of weights up to 22 kg. To enable the design of this standard, work is required to identify the geometrical and the load interface. The intent of this study is to gather information regarding the geometrical interface.

Objective

The aim of this task is to identify a potential geometrical zone, relative to the ISOFIX anchorages, where a third ISOFIX type anchorage may be positioned. This anchorage is intended for connecting with a support bar with an ISOFIX connector.

Methods

Measurements were taken with a measurement fixture (see figure 1). The design of the fixture was based on the envelopes R2 (and R3) defined in ISO 13216-3:2006; the lower 60 mm section of the envelope was milled out of a robust material and constitutes the base of the fixture. Moveable and adjustable arms with scales were screwed onto the fixture base. The measurements are defined in figure 2. The x and z coordinates were calculated according to the formulas in Equation 1 and Equation 2. The third terms in each equation are corrections to compensate for the height between the ISOFIX connectors and the top or the measurement fixture.

$$x = -A * \cos(\alpha) - B * \sin(\beta - 90) + 45 * \sin(\alpha)$$ Equation 1

$$z = A * \sin(\alpha) - B * \cos(\beta - 90) + 45 * \cos(\alpha)$$ Equation 2

Results

The vehicles that were measured are listed in table 1. Six vehicles were measured; they ranged from small vehicles to midsize vehicles, a multipurpose vehicle and a van. The results of the measurements are shown in table 1. Based on the measurements, the coordinates in x and z (vehicle coordinate system) relative to the ISOFIX anchorages were calculated. These coordinates are shown in figure 3.

Table 1 Measurement results (measured with the measurement fixture).

Vehicle make	Vehicle model	Model year	A (mm)	B (mm)	alfa (grader)	beta (grader)	Point position	Comment	x	z
Hyundai	H-1 kombi	2008	495	440	11.9	90	floor, rearmost point	flat floor (no heel kick)	-475	-294
VW	Golf	2008	565	410	10.8	90	floor, rearmost point		-547	-260
VW	Golf	2008	545	330	10.8	89	heel kick, mid height		-521	-184
VW	Golf	2008	535	250	10.8	80	heel kick, horizontal plane by seat		-474	-102
Land Rover	Freelander	2008	575	455	18.7	90	floor, rearmost point		-530	-228
Land Rover	Freelander	2008	590	480	18.7	86	heel kick, mid height		-511	-247
Toyota	Auris	2008	550	465	16.4	90	floor, rearmost point		-515	-267
Toyota	Auris	2008	575	420	16.4	85.6	heel kick, mid height		-507	-213
Toyota	Auris	2008	590	330	16.4	84.2	heel kick, horizontal plane by seat		-520	-119
Volvo	V70	2008	570	435	14.6	90	floor, rearmost point		-540	-248
Volvo	V70	2008	570	340	14.6	86	heel kick, mid height		-517	-152
Infiniti	G35x	2007	560	420	8.3	90	floor, rearmost point		-548	-295
Infiniti	G35x	2007	580	300	8.3	83.7	heel kick, mid height		-535	-170

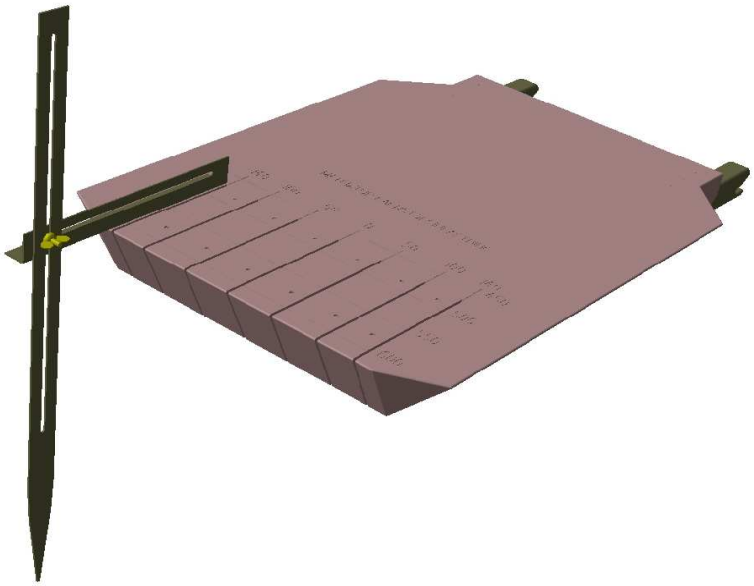

Figure 1 The measurement fixture. The base with the connectors comply with the ISO 13216-3:2006 R2 envelope. The scales are moveable in y.

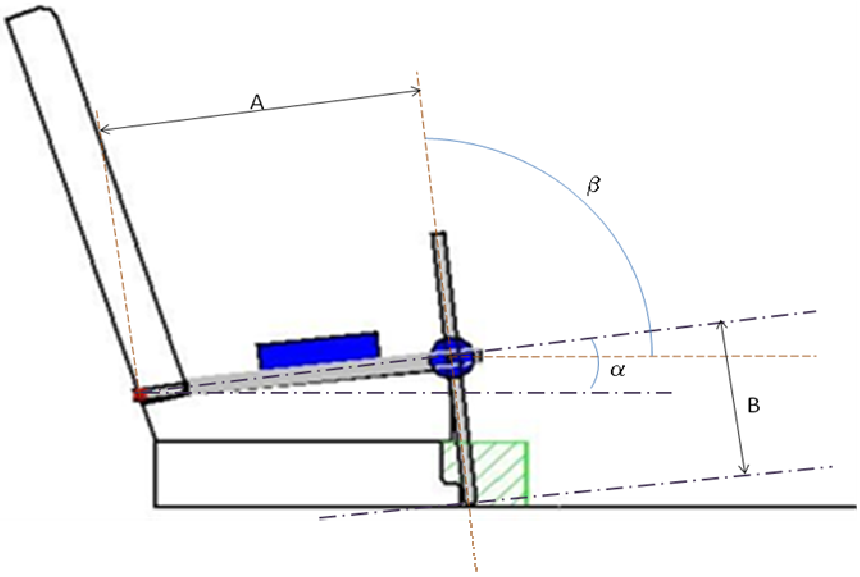

Figure 2 Definitions of measurements.

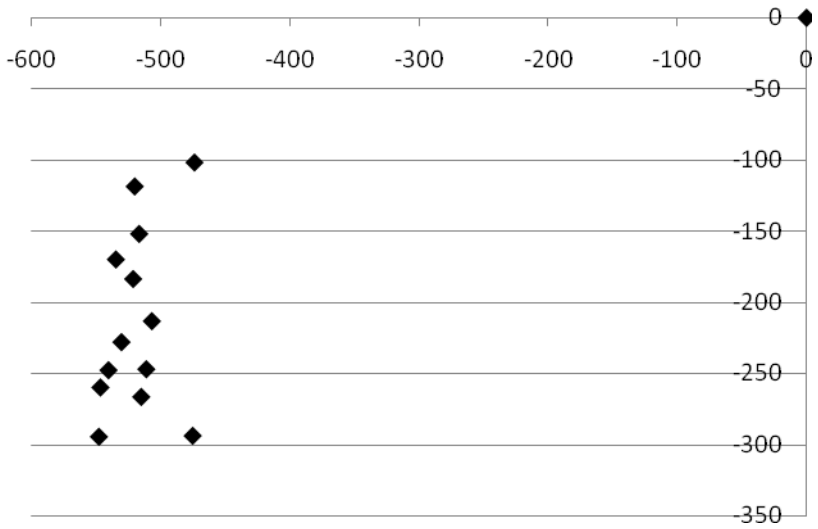

Figure 3 Coordinates of points on the floor relative to the ISOFIX anchorages (positioned in the origo).