ICS 01.110
T04

团　　体　　标　　准

T/ZSA 54-2018

自动驾驶车辆封闭试验场地技术要求

Technical requirements of closed test site for automated vehicle

2018-12-29 发布　　2019-3-1 实施

中关村标准化协会　　发布

目　次

前　言

本标准按照GB/T1.1-2009《标准化工作导则_第1部分》给出的规则起草。

本标准作为《北京市关于加快推进自动驾驶车辆道路测试有关工作的指导意见（试行）》及《北京市自动驾驶车辆道路测试管理实施细则（试行）》配套落实技术文件。

请注意本文件的某些内容可能涉及专利。中关村标准化协会不承担识别这些专利的责任。

本标准由中关村标准化协会技术委员会提出并归口。

本标准负责起草单位：北京智能车联产业创新中心有限公司。

本标准参加起草单位：北京百度网讯科技有限公司、北京新能源汽车股份有限公司、北汽福田汽车股份有限公司、中国信息通信研究院、北京千方科技股份有限公司。

本标准主要起草人：孙亚夫、吴琼、王德、葛昱、邹迎、夏曙东、李倩、汤立波、宋德王、尹颖、邢亮、倪鹏、党利冈、毕超、王哲、葛雨明、于润东、孙松源、甘家华、张立博、崔岳。

自动驾驶车辆封闭测试场地技术要求

1 范围

本标准规定了自动驾驶车辆封闭测试场地所包含的测试训练场地、能力评估场地和配套办公及服务设施等技术要求。

本标准适用于自动驾驶车辆研发测试训练所需要的测试训练场地与道路测试能力评估所需的能力评估场地建设要求。

2 规范性引用文件

下列文件对于本文件的应用是必不可少的。凡是注日期的引用文件，仅注日期的版本适用于本文件。凡是不注日期的引用文件，其最新版本（包括所有的修改单）适用于本文件。

北京市关于加快推进自动驾驶车辆道路测试有关工作的指导意见（试行）

北京市自动驾驶车辆道路测试管理实施细则（试行）

T/CMAX 116-01—2018 自动驾驶车辆道路测试能力评估内容与方法

GB/T 28592-2012 降水量等级

GB/T 27964-2011 雾的预报等级

GB 5768.2 道路交通标志和标线　第2部分：道路交通标志

GB 5768.3 道路交通标志和标线　第3部分：道路交通标线

GB 14887 道路交通信号灯

GB 14886 道路交通信号灯设置与安装规范

GB 50156 加油站设计与施工规范

GB 50034 建筑照明设计标准

GB 50057 建筑物防雷设计规范

GB 50162 道路工程制图标准

GB 50016 建筑设计防火规范

GB 50311 综合布线系统工程设计规范

GB 50343 建筑物电子信息系统防雷技术规范

JTG D80 高速公路交通工程及沿线设施设计通用规范

JTG D81 公路交通安全设施设计规范

CJJ 37-2012 城市道路工程设计规范

CJJ 45 城市道路照明设计标准

DB11/T 650 公共汽电车站台规范

3 术语和定义

下列术语和定义适用于本文件。

3.1 评估车型 vehicle model for capability assessment

评估车型包含小型客车、中型客车、大型客车、城市公交车、小型货车、中型货车、大型货车，具体参数及要求参照T/CMAX 116-01—2018《自动驾驶车辆道路测试能力评估内容与方法》中评估内容评估车型。

3.2 车辆日常测试 daily test for vehicle

车辆日常测试是指自动驾驶车辆在模拟特定地理区域的道路、交通流、自然环境等实际行驶场景下，开展感知、决策等测试训练。

3.3 车辆能力评估 capability assessment for vehicle

车辆能力评估是指自动驾驶车辆按照T/CMAX 116-01—2018《自动驾驶车辆道路测试能力评估内容与方法》要求，对自动驾驶车辆进行能力评估测试。

3.4 能力评估分级 classification of capability assessment

能力评估分级共5级，编号为Tn，n取值为1至5,具体评估内容参照T/CMAX 116-01—2018《自动驾驶车辆道路测试能力评估内容与方法》中评估分级。

3.5 封闭测试场地 closed test site

为自动驾驶车辆提供日常测试训练、能力评估、验证等服务的全封闭的场地环境，包含测试训练场地、能力评估场地等。

3.5.1 测试训练场地 test site of training

模拟特定地理区域的道路、交通流、自然环境等实际行驶场景的自动驾驶车辆测试训练的全封闭的场地环境，测试训练场地对特定地理区域内的道路及附属设施模拟覆盖应具有一定的全面性。

3.5.2 能力评估场地 capability assessment site

按照T/CMAX 116-01—2018《自动驾驶车辆道路测试能力评估内容与方法》要求准备的自动驾驶车辆能力评估的全封闭的场地环境。测试训练场地是能力评估场地的基础，能力评估场地是测试训练场地内部分场景依据能力评估内容与方法要求的标准化设置。

4 场地设置一般要求

4.1 一般规定

4.1.1 场地规划布局应统筹考虑交通组织、测试路线及出入口、路网结构、道路种类、建筑布置、竖向设计、绿化及空间环境等因素，合理布局。

4.1.2 场地规划布局、设施与设施设置应具备京津冀地理区域交通特征。

4.1.3 应设置配套办公及服务设施等功能性场所，注意公共卫生设施的配套。场地应按人车分离的原则布置隔离、导流等设施，合理组织人流、车流，确保安全。

4.1.4 场地建筑布置与设计应符合相应的建筑设计规范。

4.1.5 场地道路设计应参照 JTG D80、JTG D81、CJJ 37。路面设计轴载：标准轴载 BZZ-100。除测试路段外，积雪或冰冻地区的主路最大纵坡不应大于 3.5%，其它地区主路最大纵坡不应大于 6%。除按要求设计的积水路面外，道路排水应顺畅，不应有积水。

4.1.6 场地道路路面两侧与路外场地落差超过 0.5m，且坡度超过 4%时，应在道路边缘设置防护设施。场地通道与道路衔接出入口处应满足行车视距的要求。

4.1.7 采用路缘石作为道路边缘线的，路缘石结构与强度应能承受测试车辆碾压，不应错位、倾倒。

4.1.8 绿化布置应符合道路建筑限界要求并不应妨碍行车视距。

4.1.9　场地竖向规划设计应包括地形、地貌的合理利用、确定道路控制高程和地面排水规划。当自然地形坡度大于 8%时，场地应采用台式布置，台地之间应用挡土墙或护坡连接。

4.2　场地设计

4.2.1　场地设计分为初步设计和施工图设计。

4.2.2　初步设计应包括技术方案、设计图纸、项目功能指标计算、主要设备材料清单和工程概算等四项内容。其中：

a）　技术方案包括：现状与需求分析；总体设计，结构、功能、通信广播、供电、环境适应性设计；实施计划；其他约定设计内容；

b）　设计图纸包括：设计说明；场地平面图；建筑及内部布置平面图；标志标线设置方案。

4.2.3　设计单位根据经批准的初步设计文件等开展施工图设计。项目竣工后，设计单位应根据施工图设计图纸、图纸会审记录、设计变更等进行竣工图绘制。

4.2.4　场地设施设计工程制图应符合 GB 50162 的规定。其他项目设计应符合国家或行业相关制图标准要求。

5　测试训练场地

5.1　场地设置要素

依据T/CMAX 116-01—2018《自动驾驶车辆道路测试能力评估内容与方法》中的评估分级、评估车型，按照不同评估分级、评估车型的自动驾驶车辆对测试训练场地内的要求不同，对场地内各设置要素进行划分。

5.1.1　道路主体

5.1.1.1　道路等级、建设长度、设计行车速度和设计可通行车辆类型

场地内道路等级、道路建设长度、设计行车速度与设计可通行车辆类型如表格1：

表格 1 道路分级与建设长度、设计行车速度与设计可通行车辆类型要求

道路等级	能力评估分级	建设长度（m）	设计行车速度（km/h）	设计可通行车辆类型
高速公路主路	T5	≥500	≥100	小型客车、中型客车、大型客车、城市公交车、小型货车、中型货车、大型货车
高速公路出入口、匝道及其他	T5	-	≥40	
快速路主路	T5	≥500	≥80	
快速路出入口及其他	T5	-	≥40	
城市主干路	T1	≥500	≥60	
城市次干路	T1	≥500	≥50	
城市支路	T1	≥500	≥40	
城市其他道路	T1	-	≥40	
四级公路	T3	≥300	≥40	小型客车、中型客车、大型客车、城市公交车、小型货车、中型货车、大型货车
等外公路	T3	≥300	≥40	小型客车、中型客车、小型货车、中型货车

以上依据JTG D80、JTG D81、CJJ 37设计。

5.1.1.2 车道类型

场地内各类各级道路车道类型要求如表格2：

表格 2 车道类型要求

道路等级	能力评估分级	车道类型具体要求
高速公路主路	T5	应急车道，行车道不少于 3 条，含超车道
高速公路出入口、匝道及其他	T5	应急车道，行车道

快速路主路	T5	行车道不少于 3 条
快速路出入口及其他	T5	行车道不少于 1 条
城市主干路	T4	潮汐车道，右转专用道，待转区
城市次干路	T3	公交专用道，主辅路，非机动车道，机非混行道
城市支路	T2	双向 4 车道及以上
四级公路	T1	单向两车道及以上
等外公路	T3	双向 2 车道及以上

以上依据JTG D80、JTG D81、CJJ 37设计。

5.1.1.3 交叉口

场地内各类各级道路交叉口类型要求如表格3：

表格 3 交叉口类型要求

交叉口类型	能力评估分级	具体要求
高速公路/快速路与高速公路/快速路交叉口	T5	有条件可设计高速公路/快速路与高速公路/快速路交叉口
高速公路与普通公路/道路出、入口	T5	高速公路与普通公路/道路出、入口
快速路与城市道路的出、入口	T5	快速路与城市道路的出、入口
异形交叉路口	T4	含有信号灯的 5 方向及以上异形交叉路口
铁路道口	T4	铁路与城市道路/普通公路交叉口
主辅路出入口	T3	主路与辅路出入口
立交	T3	可做平面交叉模拟四分之一及以上苜蓿叶立交
环岛	T3	5 出入口及以上双车道环岛
十字型交叉口、T 字型	T4	含待转区的路口或渠化路口

交叉口、X 或 Y 字型交叉口	T3	含信号灯双向 4 车道及以上道路与双向 2 车道及以上道路交叉口；无信号灯控制交叉口
	T1	含信号灯双向 2 车道道路与双向 2 车道道路交叉口；含信号灯双向 2 车道道路与单向 1-2 车道道路交叉口
行人通行路口	T1	含信号灯道路中间行人通行路口

以上交叉口，需要考虑不同等级道路之间的交叉，并依据JTG D80、JTG D81、CJJ 37设计。

5.1.1.4 道路特征

场地内道路特征要求如表格4：

表格 4 道路特征要求

道路特征	能力评估分级	具体要求
覆盖特征	T5	需设计积水路面，水深不少于 20cm，长度不少于 30m，覆盖车道不少于 1 条
形态特征	T4	需设计弯道、连续弯道、急转弯道。弯道曲率半径范围：15m～40m
	T3	需设计坡道。坡道的坡度范围：2%～10%，有条件的可以设计 12%以上的坡道
遮挡特征	T4	需设计隧道。隧道长度不少于 100m
	T3	需设计林荫道，建筑物附近道路。林荫道长度不少于 50m，建筑物附近道路不少于 100m。有条件可以模拟立交桥、高架路等桥下道路
材质特征	T4	需设计沥青路面、水泥路面、砂石路面等路面，道路长度均不少于 100m。需设计含雨篦子、电缆井盖及铁板等路面，其中雨篦子宽度不少于 30cm，铁板宽度不少于 2m，覆盖车道均不少于 1 条

以上依据JTG D80、JTG D81、CJJ 37设计。

5.1.2 交通标志、交通标线与交通信号灯等道路附属设施

场地内交通标志、交通标线、交通信号灯要求如表格5：

表格 5 交通标志、交通标线与交通信号灯要求

交通标志、标线与信号灯		能力评估分级	具体要求
交通标志	指示标志	T4	应设计包含 GB 5768.2 中的潮汐车道、可变导向车道等标志
		T3	应设计包含 GB 5768.2 中的掉头等标志
		T2	应设计包含 GB 5768.2 中的向左转弯、向右转弯、公交专用道、左转和掉头等标志
		T1	应设计包含 GB 5768.2 中的直行、直行和向左转弯、直行和向右转弯、靠右侧道路行驶、靠左侧道路行驶、单行路、右转车道、人行横道等标志
	警告标志	T1	应设计包含 GB 5768.2 中的注意儿童、注意行人等标志
	禁令标志	T1	应设计包含 GB 5768.2 中的禁止通行、禁止驶入、禁止左转、禁止右转、禁止直行、禁止掉头、限制速度、停车让行、减速让行、会车让行等标志
	指路标志	T1	不做要求。依据实际道路情况，按照 GB 5768.2 要求设置
	道路施工安全标志	T1	应设计包含 GB 5768.2 中的所有道路施工安全标志
	辅助标志	T1	应设计包含 GB 5768.2 中的学校、时间范围等标志
交通标线	指示标线	T4	应施划 GB 5768.3 中包含的左转弯待转区线、可变导向车道线等
		T1	应施划 GB 5768.3 中包含的双向两车道路面中心线、车行道分界线、车行道边缘线、人行横道线、停车位标线等
	禁止标线	T1	应施划 GB 5768.3 中包含的禁止超车线、停止线、停车让行线、减速让行线、导流线、网状线、专用车道线等

	警告标线	T1	不做要求。依据实际道路情况，按照 GB 5768.3 要求施划
交通信号灯		T4	应设置 GB 14887 中包含的铁路道口信号灯，有条件的可实现车道信号灯
		T3	应设置 GB 14887 中包含的移动式交通信号灯、闪光警告信号灯、非机动车信号灯
		T1	应设置 GB 14887 中包含的机动车信号灯、方向指示信号灯、人行横道信号灯

交通标志应依据实际道路情况，按照GB 5768.2要求设置。

交通标线应依据实际道路情况，按照GB 5768.3要求施划。

交通信号灯应依据实际道路情况，按照GB 14886要求设置，可以以路口为单位安装不同款式的交通信号灯。

5.1.3 交通模拟设施

场地内交通模拟设施要求如表格6：

表格 6 道路其他设施要求

设施类型	能力评估分级	具体要求
模拟湿滑路面设施	T5	应建设湿滑路面，附着系数不大于 0.3，长度不少于 50m，用于通过湿滑路面测试训练与能力评估
模拟雨天设施	T5	应建设模拟雨天设施，长度不少于 100m，应能模拟（24 小时降雨量，单位 mm）：中雨（10.0～24.9），大雨（25.0～49.9），有条件可以模拟暴雨（50.0～99.9），用于通过雨区道路测试训练与能力评估
模拟雾天设施	T5	应建设模拟雾天设施，长度不少于 100m，应能模拟（能见度 V，单位 m）：大雾（500≤V＜1000），浓雾（200≤V＜500），强浓雾（50≤V＜200），特强浓雾（V＜50），用于通过雾区道路测试训练与能力评估

模拟夜间路灯设施	T5	应在部分城市道路上建设路灯系统，设计依据 CJJ 45，包括黄色、白色两种灯光，用于夜间行驶测试训练与能力评估
模拟光照设施	T5	有条件的可建设模拟光照设施，应能模拟弱光 200lx-1600lx，强光 20klx～30klx 范围阳光直射
模拟收费站	T5	应建设不少于 1 处模拟收费站设施，应包含双向不少于 2 个收费口,包含模拟 ETC 收费口、模拟人工收费口,设计依据 JTG D80 及 JTG D81
模拟加油站	T5	应建设不少于 1 处模拟加油站设施，不少于 2 个车道，不少于 1 处加油位置，尺寸设计可参考 GB50156
模拟充电站	T5	应建设不少于 1 处模拟充电设施，不少于 1 个停车位
模拟高速服务区	T5	应建设不少于 1 个模拟高速服务区，应包括加油站、充电站、停车场等
模拟街景设施	T4	应建设模拟街景设施，长度不少于 100m，高度不低于 8m。用于网联通信、视距遮挡测试
模拟停车场	T4	应在城市道路路侧施设不少于 3 个以上路侧停车位。有条件的可建设独立停车场
模拟限高设施	T4	应建设不少于 1 处模拟限高设施
模拟限宽设施	T4	应建设不少于 1 处模拟限宽设施
模拟公共汽电车站台	T2	应建设不少于 1 处模拟公共汽电车站台设施，设计建设依据 DB11/T 650
道路隔离设施与安全设施	T2	应依据道路实际情况，设置护栏、隔离墩、绿化隔离带等多种多处软硬隔离设施；高速公路应包含反光标志、防眩设施
减速带	T2	应建设不少于 1 处减速设施

以上设施中，模拟雨天设施应依据实际情况，按照GB/T 28592-2012要求设置；模拟雾天设施应依据实际情况，按照GB/T 27964-2011要求设置；交通标志应依据实际情况，按照GB 5768.2要求设置；交通标线应依据实际情况，按照GB 5768.3要求施划。

5.1.4 网联通信设施

5.1.4.1 网联通信路侧设备技术要求

场地内网联通信路侧设备网联通信协议、性能和安全、互联互通和互操作要求需符合:

a) 中国标准体系:T/ITS 0013.3-2014《合作式智能运输系统专用短程通信》，CCSA 行业标准：2015-1616T-YD《基于 LTE 的车联网无线通信技术总体技术要求》、2016-1853T-YD《基于 LTE 的车联网无线通信技术空中接口技术要求》、2018-0173T-YD《基于 LTE 的车联网通信安全技术要求》、2018-1788T-YD《基于公众电信网的联网汽车信息安全技术要求》、2018-0175T-YD《基于 LTE 的车联网无线通信技术 路侧设备技术要求》、2018-0174T-YD《基于 LTE 的车联网无线通信技术 基站设备技术要求》，C-ITS 和 T/CSAE 团体标准：53-2016《合作式智能运输系统 车用通信系统 应用层及应用数据交互标准》，IMT-2020(5G)推进组 C-V2X 工作组发布的《LTE-V2X 终端功能、性能和终端互操作测试规范》或

b) 美国标准体系:SAE J2735、SAE J2945、IEEE 1609.3、IEEE 1609.4、IEEE 1609.2、IEEE 802.11P 等标准。

5.1.4.2 网联通信路侧设备部署

网联通信路侧设备应依据场地内道路实际情况及自动驾驶评估内容专项要求合理部署。

5.1.5 高精度定位增强设施

5.1.5.1 高精度定位差分信号

场地内需能提供高精度定位差分信号，差分信号需满足：

a) 北斗和 GPS 两种制式差分信号；

b) 支持 RTK 差分信息；

c) 支持网络等多种接收模式。

如场地无差分信号覆盖，可在场地布设差分基站，自行播发差分信号，信号需满足以上要求。

5.1.5.2 差分基站的部署

差分基站的选择与部署应选取：

c) 地质条件良好、点位稳定；

d) 视野开阔，周围无高度角超过 10° 的障碍物；

e) 周围无信号反射物；

f） 能方便地播发或传送差分改正信号的地方。

5.2 场地布置与平面设计

5.2.1 场地平面布置

5.2.1.1 场地功能分区设计

场地应依据不同的交通流特征，进行功能区域划分，避免干扰，出现安全隐患。可按照如下进行功能分区布置：

a） 高速测试区，包括高速公路及附属设施；

b） 城市测试区，包括城市道路及附属设施；

c） 乡村测试区，包括城乡公路、等外公路及附属设施。

有条件的场地，可以考虑设置：

a） 自由测试区，如动态广场；

b） 其他独立测试区，如停车场、库等。

5.2.1.2 场地平面布置应按功能分区及场地运行车辆容量和场地小时期望测试训练车次的需求布设。同时做好测试训练路线方案，自然形成车辆流动的测试训练线路。正确组织车流、人流，合理布设各种道路附属设施及交通流模拟设备。场地平面线形应与地形、地质、水文等结合。

5.2.1.3 道路平面设计、纵断面设计应处理好直线与平曲线的衔接，合理设置缓和曲线、超高、加宽等，其设置标准参照 JTG D80、JTG D81、CJJ 37。

5.2.1.4 标识、标志设置应符合路段运行车速和 GB 5768.2、GB 5768.3 的要求。

5.2.1.5 城市道路外 10m 内为缓冲区，不应设置其他物体，如无法规避，需要采用轮胎等软性隔离物进行缓冲。

5.2.2 视距

5.2.2.1 场地内不应存有妨碍行车视线的障碍物，其视野范围内离地高度 1～2m 区域中不应有妨碍观察车辆视线的障碍物。

5.2.2.2 场地内应部署监控设备，能够观察测试训练车辆和场地的整体情况。

5.2.3 隔离

场地与外界应采用物理隔离，出入口需设有卡口设施。

5.3 场地交通流模拟设备

场地内交通流模拟设备要求如表格7：

表格 7 交通流模拟设备要求

设备类型		设备要求
模拟机动车		应提供小型客车模拟设备不少于 1 套，有条件可提供公交车、小型货车、三轮车、摩托车模拟设备
模拟非机动车		应提供自行车模拟设备不少于 1 套，有条件可提供电动车模拟设备
模拟行人及动物		应提供成人、儿童、老人模拟设备不少于 1 套，有条件可提供动物模拟设备
其他临时限制模拟设施及物品	施工区	应能提供施工区域模拟设施
	障碍物	应能提供不少于 5 种道路模拟障碍物
	交通管控与交通事故	应能提供移动式交通管控的模拟设施

6 能力评估场地

6.1 一般规定

能力评估场地按评估车型和评估分级级别分别设置，设置项目应符合T/CMAX 116-01—2018《自动驾驶车辆道路测试能力评估内容与方法》要求。

6.2 道路主体等基本设置

能力评估场地的道路主体及道路附属设施、交通模拟设施、网联通信设施、高精度定位增强设施采用测试训练场地内既有设置，具体如下：

6.2.1 T1 级能力评估道路

a) 直道，单向两车道及以上；

b) 含有信号灯控制的交叉路口、人行横道等。

6.2.2 T2 级能力评估道路

a) 含符合 T1 级能力评估道路；

b) 直角转弯道路和曲线转弯道路；

c) 双向 4 车道及以上，含软硬隔离设施；

d) 含公共电汽车站台或公交港湾等。

6.2.3 T3 级能力评估道路

a) 含符合 T2 级能力评估道路；

b) 含机非混行道路、主辅路、起伏路、林荫路；

c) 含公交专用道、非机动车道、人行专用道；

d) 含 5 出入口及以上双车道环岛，主辅路出入口，及含有信号灯的双向 4 车道及以上道路与双向 2 车道及以上道路交叉口或无信号灯控交叉口等；

e) 含模拟四分之一及以上苜蓿叶立交。

6.2.4 T4 级能力评估道路

a) 含符合 T3 级能力评估道路；

b) 含转弯匝道、急转弯道、连续弯道道路；

c) 含隧道、潮汐车道等；

d) 含水篦子、铁板、铁轨等路面；

e) 含水泥、砂石等路面；

f) 含有信号灯的 5 方向及以上异形交叉路口；

g) 含待转区的路口、渠化路口、铁路道口等；

h) 含路侧与场地停车位等。

6.2.5 T5 级能力评估道路

a) 含符合 T4 级能力评估道路；

b) 含高速公路、城市快速路等；

c) 含服务区、收费站、充电站、限宽、限高设施等；

d) 含湿滑、积水、遗撒等路面。

6.3 能力评估专项场地设置

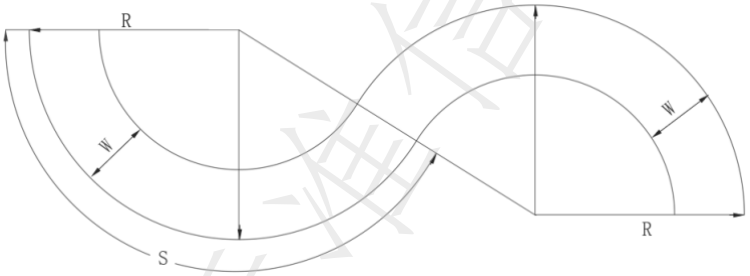
6.3.1　交通标志、交通标线、交通信号灯、交通指挥手势、紧急停车、人工介入后的可操作性、紧急情况处置、起步、跟车、变更车道、直行通过路口、通过人行横道线、路口左转弯、路口右转弯、路口掉头、靠边停车、通过公共汽车站、会车、通过环岛、主辅路行驶、通过学校区域、超车、避让应急车辆、可变导向车道、待转区。

上述评估专项场地依据测试训练场地的实际道路来动态设置，不固定场地设施。

6.3.2　曲线行驶

曲线行驶项目图形应按照图1设置。

曲线行驶场地实际部署，可以通过测试训练场地内依图形设计实际道路或通过动态广场内标志、标线和隔离设施设置来实现。



R ——半径，取值：大型货车为14m，中型货车、大型客车、城市公交车为12m，小型客车、小型货车、中型客车为9.5m；

W ——路宽，取值见下表：

大型货车取值见下表：

轴距：L	L=5	5＜L＜6	6≤L＜7	7≤L＜8	L≥8
路宽：W	4.0	4.5	5.0	5.6	6.4

中型货车、大型客车、城市公交车取值见下表：

轴距：L	L＜4	4≤L＜5	5≤L＜6	6≤L＜7	L≥7
路宽：W	3.7	4.2	4.7	5.4	6.2

小型客车、小型货车、中型客车取值见下表：

轴距：L	L＜3	3≤L＜4	4≤L＜5	5≤L＜6	L≥6
路宽：W	3.7	4.0	4.5	5.2	6.2

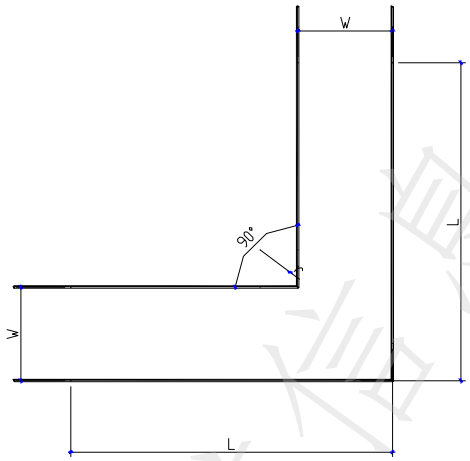
S ——弧长，取值不少于八分之三圆周长。

图 1 曲线行驶项目图形

6.3.3 直角弯道行驶

直角弯道行驶项目图形应按照图2设置。

直角弯道行驶场地实际部署，可以通过测试训练场地内依图形设计实际道路或通过动态广场内标志、标线和隔离设施设置来实现。



L ——路长，取值大于等于 1.5 倍车长；

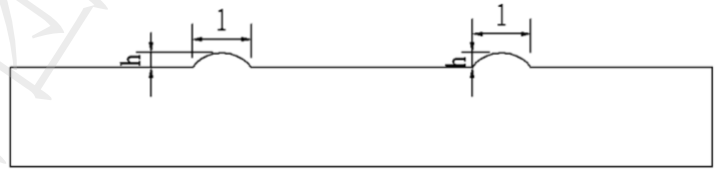
W ——路宽，取值：大型客车，城市公交车和大型货车为轴距加 1.2m，中型客车、中型货车为轴距加 1.5m，小型客车、小型货车为轴距加 1.7m。

图 2 直角弯道行驶项目图形

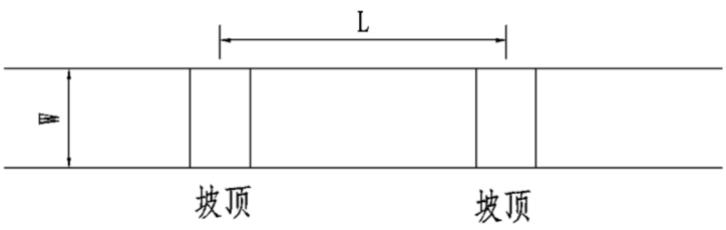
6.3.4 双凸路行驶

双凸路行驶项目图形及设施应按图3设置。

双凸路行驶场地实际部署，可以通过测试训练场地内依图形设计实际道路来实现。



截面图



俯视图

L ——凸路引道及间距长度，取值：大型客车、城市公交车、大型货车大于 12m，中型客车、中型货车大于 9.0 m，小型客车、小型货车大于 6.0m；

h ——凸路高，取值 0.06～0.12m；

W ——路宽，取值大于等于 3.5m；

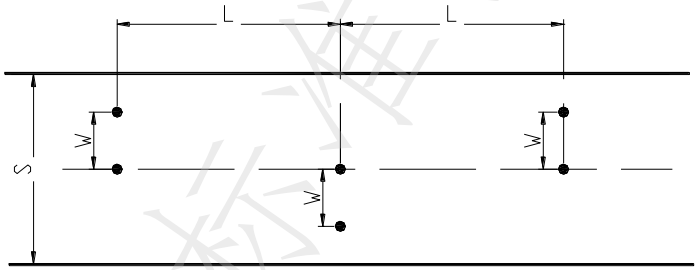
l ——凸路长度，取值 1.0m。

图 3 双凸路行驶项目图形及设施

6.3.5 限宽路段行驶

限宽路段行驶项目图形及设施应按图4设置。

限宽路段行驶场地实际部署，可以通过测试训练场地内依图形设计实际道路与设施或通过动态广场内标志、标线和隔离设施设置来实现。



● ——限宽设施；

S ——路宽，取值大于等于 7.0m；

W ——限宽路段宽，取值车宽加 0.7m；

L ——限宽设施前后间距，取值 3 倍车长。

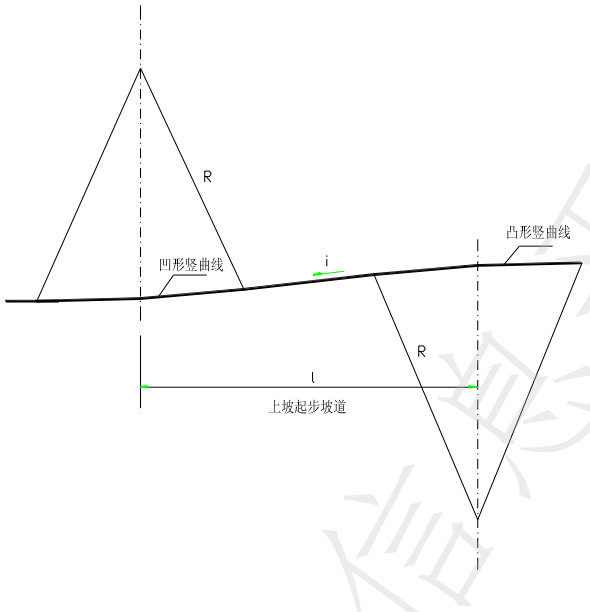
图 4 限宽路段行驶项目图形及设施

6.3.6 窄路掉头

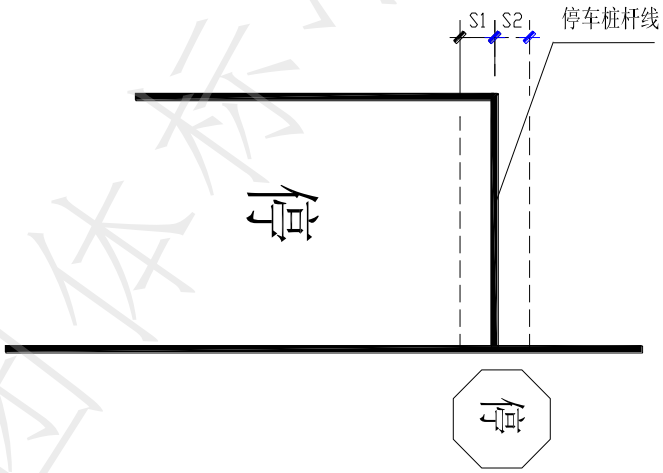
窄路掉头路段直线长取值大于等于20m，路段宽度取值为轴距加5.0m；车头驶抵方向侧向净空取值大于等于2.0m，车尾倒车方向侧向净空取值大于等于4.0m。

6.3.7 坡道停车和起步

坡道停车和起步项目图形及设施应按图5设置。



截面图



俯视图

— ——停车桩杆线，线宽取值 0.3m；

i ——坡度，取值 10%；

l ——坡长，取值大于等于 15m（含竖曲线全长）；

R ——竖曲线半径，取值大于 30m；

S1、S2 ——停车控制线到停车桩杆线中心距离，取值 0.65m。

图 5 坡道停车和起步项目图形及设施

上坡起步坡道坡度路段上端处设起点标线，起点标线为单停车线实线。

坡道停车停车点位应设停车让行标志、停车桩杆线，停车桩杆线前后设停车控制线，设置位置应在坡底向上车长加3.0m以上，坡顶缓坡以下。标志标线设置应当符合GB 5768.2、GB 5768.3的要求。

6.3.8 通过模拟苜蓿叶式立交

测试训练场地内建设有四分之一及以上苜蓿叶式平面立交模拟场地。

6.3.9 通过隧道

场地实际部署，可以通过测试训练场地内的模拟隧道来实现。

模拟隧道内无照明时，其最暗处白天照度取值小于50lx；

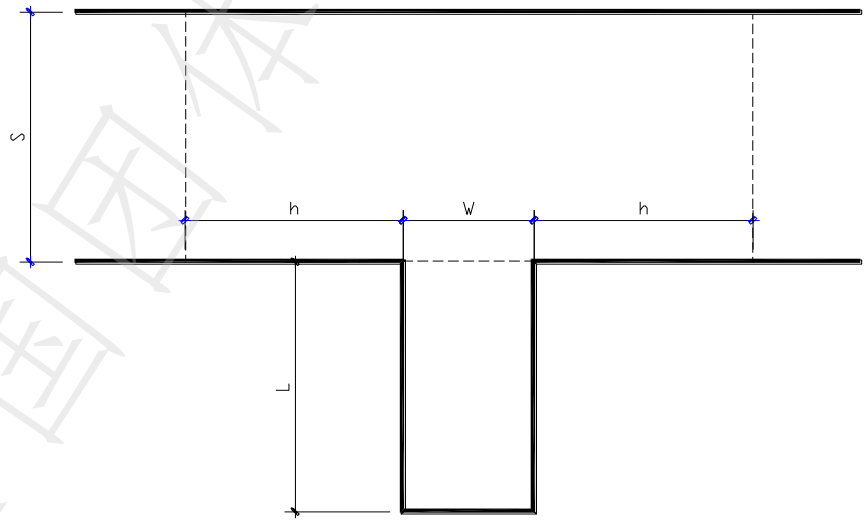
模拟隧道直线行车道长度取值大于等于100m，隧道内净空取值大于等于5.0m；

模拟隧道入口和出口应当设置前照灯使用标志，标志设置符合GB 5768.2的要求。

6.3.10 停车入库

停车入库项目图形应按图6设置。

停车入库场地实际部署，可以通过测试训练场地内依图形设计实际停车场停车位或通过空旷场地内标志、标线和隔离设施设置来实现。



W ——库宽，取值车宽加 0.6m；

L ——车位长，取值车长加 0.7m；

S ——车道宽，取值 1.5 倍车长；

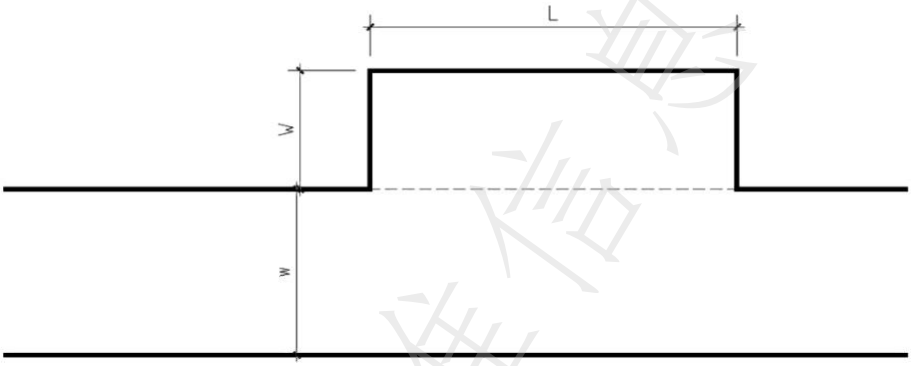
h ——车库距控制线距离，取值 1.5 倍车长。

图 6 停车入库项目图形

6.3.11 侧方停车

侧方停车项目图形应按图7设置。

侧方停车场地实际部署，可以通过测试训练场地依图形设计实际道路路侧停车位或通过动态广场内标志、标线和隔离设施设置来实现。



L ——车位长，取值：大型客车、城市公交车为 1.5 倍车长减 1.0m，小型客车、小型货车为 1.5 倍车长加 1.0m，其他车型为 1.5 倍车长；

W ——车位宽，取值车宽加 0.8m；

w ——车道宽，取值 1.5 倍车宽加 0.8m。

图 7 侧方停车项目图形

6.3.12 通过雨区道路

场地实际部署，可以通过测试训练场地内模拟雨天设施来实现。

模拟雨天设施直线行车道长度取值大于等于100m，达到中雨、大雨效果。

6.3.13 通过雾区道路

场地实际部署，可以通过测试训练场地内模拟雾天设施来实现。

模拟雾天设施直线行车道长度取值大于等于100m，能够达到强浓雾和特强浓雾效果。

6.3.14 通过湿滑路面

场地实际部署，可以通过测试训练场地内的模拟湿滑路面来实现。

模拟湿滑路面附着系数不大于0.3，长大于等于50m，宽大于等于4m。湿滑路面外侧应设置对车辆无损的安全防护设施。

6.3.15 通过遗撒路面

场地实际部署，可以通过测试训练场地内模拟遗撒道路来实现。模拟路面外侧应设置对车辆无损的安全防护设施。

6.3.16 夜间行驶

场地实际部署，可以通过测试训练场地内建设覆盖长度不低于 350m 路灯系统的道路来实现，路灯设计标准依据 CJJ 45。

6.3.17 网联驾驶

场地设置依据测试训练场地的实际道路情况来设置。

7 配套办公及服务设施场地

7.1 场地设置要素

7.1.1 场地内容要素

场地应提供面向厂商的办公场地:车辆调试车间、办公环境等，有条件的可提供休息室；场地自身需要的办公场地：接待中心、监控中心，办公室、会议室与休息室，机房等。

7.1.2 车辆调试车间应配置举升机、工具箱等。

7.2 场地布置与平面设计

7.2.1 场地平面布置应按场地接待厂商数量、场地运行车辆容量及自身办公人员数量的需求布设。

7.2.2 场地内应部署监控设备，能够观察各运行测试车辆和场地的整体情况。

7.2.3 隔离场地与外界应采用物理隔离，出入口需设置卡口设施。

8 场地基础设施

8.1 消防

场地应配备消防设备，有条件的场地可配备紧急救护药品和设备以及相应安全监控设备，设施设置应符合GB 50016的要求。

8.2 给排水

场地建设应有完整的给排水设计。给水设施应满足场地设施办公、生活、绿地和消防的需要。排水设施应保证场地设施正常使用和路基、路面不因积水而损毁。按照操作规范定期维护给排水设施。

8.3 电源及供电

8.3.1 供电电源就近引自附近的变配电所，宜按三级负荷进行供电。电源应选用交流电压220V 或 380V，三相四线制系统。对配套办公及服务设施场地内机房应当设置不间断备用电源。总配电装置应设置在专门的配电室内。

8.3.2 一般负荷宜采用树干式配电，集中负荷或重要负荷宜采用放射式配电。供电电源点至配电装置的供电线路宜采用电缆敷设，至室外各用电设备的线路宜采用电缆埋地敷设。

8.3.3 系统应采用 TN-S 接地故障保护。至室外灯具的线路需设置 PE 线。穿线用的保护金属管及灯具金属部分应与 PE 线连接。PE 线应与相线等截面。总配电装置处应设总等电位装置。

8.3.4 场地内建筑物、构筑物防雷设计应符合 GB 50057 要求。高杆灯应设避雷针进行保护，并利用金属灯杆作引下线。每盏高杆灯处应设置独立的接地装置，穿线用的金属保护管应与该装置连接。

8.3.5 照明设施按场地使用需求设置。测试场地内道路照明按 CJJ 45 中Ⅲ级执行，其它道路及场所照明按 GB 50034 有关条款执行。

8.4 场地智能信息系统

8.4.1 通信网络系统

8.4.1.1 通信网络系统应能为场地的拥有者（管理者）及场地内的各个使用者提供有效的信息接收、存贮、处理、交换、传输等信息服务。

8.4.1.2　场地内根据需要和相关规定，可分别设置场地安全监控系统、场地交通控制系统、场地出入口管理系统、场地综合管控系统。

8.4.2　弱电防雷系统

场地应结合建筑物防雷要求设置弱电防雷系统。系统设计应符合GB 50343的要求。

8.4.3　综合布线系统

场地应采用综合布线系统，并能满足场地内语音、数据、图像、监控等系统中信号传输的要求。系统设计应符合GB 50311的要求。

ICS 01.110
T04

Association Standard

T/ZSA 54-2018

Technical Requirements of Closed Test Site for Automated Vehicle

Issued Data 12-29-2018 Implemented Data 3-1-2019

Issued by Zhongguancun Standardization Association

Contents

Preface

The standard was drafted in accordance with the rules set out in Directives for Standardization - Part 1 (GB/T1.1-2009).

The standard serves as the attached technical documents for Guidance on Speeding up the Road Test Related Works for Automatic Driving Vehicles in Beijing (Trial) and Guidance and Detailed Rules for the Implementation of Road Test Management for Automatic Driving Vehicles in Beijing (Trial).

Please note that some contents in this document may involve patents. Zhongguancun Standardization Association shall not be held responsible for identifying such patents.

The standard was proposed and under the jurisdiction of Zhongguancun Standardization Association - Technical Committee.

The responsible drafting unit of this standard is Beijing Innovation Center for Mobility Intelligent (BICMI) Co., Ltd.

The participating drafting units of this standard are: Beijing Baidu Network Technology Co., Ltd., Beijing Electric Vehicle Co., Ltd., Beiqi Foton Motor Co., Ltd., China Academy of Information and Communications Technology and China TransInfo Technology Co., Ltd.

Chief drafters of this standard are: Sun Yafu, Wu Qiong, Wang De, Ge Yu, Zou Ying, Xia Shudong, Li Qian, Tang Libo, Song Dewang, Yin Ying, Xing Liang, Ni Peng, Dang Ligang, Bi Chao, Wang Zhe, Ge Yuming, Yu Rundong, Sun Songyuan, Gan Jiahua, Zhang Libo and Cui Yue.

Technical Requirements of Closed Test Site for Automated Vehicle

1 Scope

The standard specifies the technical requirements for testing and training site, capability evaluation site and supporting office and service facilities, all of which are included in closed test site for automated vehicle.

The standard applies to construction requirements for testing and training site of automated vehicle R&D test and for assessment of road test capability.

2 Normative References

The following documents are indispensable for the application of the document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Guidance on Speeding up the Road Test Related Works for Automatic Driving Vehicles in Beijing (Trial)

Guidance and Detailed Rules for the Implementation of Road Test Management for Automatic Driving Vehicles in Beijing (Trial)

T/CMAX 116-01-2018 *Contents and Methods of Field Test Capability Assessment for Automated Vehicle*

GB/T 28592-2012 *Grade of Precipitation*

GB/T 27964-2011 *Grade of Fog Forecast*

GB 5768.2 *Road Traffic Signs and Markings – Part 2: Road Traffic Signs*

GB 5768.3 *Road Traffic Signs of Markings – Part 3: Road Traffic Markings*

GB 14887 *Road Traffic Signal Lamps*

GB 14886 *Specifications for Road Traffic Signal Setting and Installation*

GB 50156 *Code for Design and Construction of Filling Station*

GB 50034 *Standard for Lighting Design of Buildings*

GB 50057 *Design Code for Protection of Structures against Lightning*

GB 50162 *Drawing Standards of Road Engineering*

GB 50016 *Code for Fire Protection Design of Building*

GB 50311 *Code for Engineering Design of Generic Cabling System*

GB 50343 *Technical Code for Protection of Buildings' Electronic Information System against Lightning*

JTG D80 *General Specification of Freeway Traffic Engineering and Roadside Facilities*

JTG D81 *Design Specification for Freeway Safety Facilities*

CJJ 37-2012 *Code for Design of Urban Road Engineering*

CJJ 45 *Standard for Lighting Design of Urban Road*

DB11/T 650 *Specifications for Bus/Trolleybus Platform*

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Vehicle model for capability assessment

Assessment applies to minibus, medium bus, large bus, urban bus, minivan, medium truck and large truck. For detailed parameters and requirements, refer to the assessed contents and vehicle model specified in T/CMAX 116-01-2018 *Contents and Methods of Field Test Capability Assessment for Automated Vehicle*.

3.2 Daily test for vehicle

This refers to perception and decision-making test and training of automated vehicles in actual driving scenarios in simulated geographic areas, such as roads, traffic flow and natural environment.

3.3 Capability assessment for vehicle

Capability assessment for vehicle means automated vehicles undergo capability assessment as per T/CMAX 116-01-2018 *Contents and Methods of Field Test Capability Assessment for Automated Vehicle*.

3.4 Classification of capability assessment

Capability assessment is classified into 5 levels and numbered by Tn, whose range is from 1 to 5. For details of assessment, please refer to assessment classification specified in T/CMAX 116-01-2018 *Contents and Methods of Field Test Capability Assessment for Automated Vehicle*.

3.5 Closed test site

The site is fully closed to provide daily test training, capability assessment and verification of automated vehicles, including test and training site and capability assessment site.

3.5.1 Test site of training

The site is fully closed to simulate the roads, traffic flow and natural environment under specific geographic area for test and training of automated vehicles. The test site should fully cover the simulated roads and auxiliary facilities in specific geographic area.

3.5.2 Capability assessment site

The site is fully closed for the capability assessment of automated vehicles as per T/CMAX 116-01-2018 *Contents and Methods of Field Test Capability Assessment for Automated Vehicle*. Test site of training serves as the basis of capability assessment site, while the latter as the standardized setting for scenarios in the former depending on assessment contents and methods.

4 General Requirements for Site Setting

4.1 General rules

4.1.1 Layout of site should be arranged reasonably by giving full considerations to the factors including traffic organization, test route, entrance/exit, road network structure, road type, architectural layout, vertical design, greening and space environment.

4.1.2 Layout of site, facilities and arrangement of facilities should bear the traffic characteristics in geographic area of Beijing – Tianjin – Hebei Region.

4.1.3 Functional sites including office and service facilities should be arranged and attention should be paid to the preparation of public health facilities. Separation and diversion facilities should be installed at site by following the principle of "separation of pedestrians and vehicles", in order to reasonably organize flow of pedestrians and vehicles and ensure safety.

4.1.4 Architectural layout of site should be designed as per code of building design.

4.1.5 Roads at site should be designed as per JTG D80, JTG D81 and CJJ 37. Designed axle load on pavement: Standard axle load of BZZ-100. Except for test road sections, the maximum longitudinal gradient should not exceed 3.5% for main road in snow or frozen area, or not exceed 6% for main roads in other areas. Except for the pavements that may gather water according to the design requirements, the roads should be able to drain water smoothly and do not gather any water.

4.1.6 Protective facilities should be built at road edge if height difference between road lateral sides and off-road places is over 0.5 m and gradient is above 4%. Site channel and road entrance/exit should satisfy the requirements of driving sight distance.

4.1.7 Kerb used as edge line of road should be characterized by good structure and strength to avoid dislocation and tilting once rolled by vehicles under test.

4.1.8 Greening should be arranged according to limit requirements of road building and not impede the driving sight distance.

4.1.9 Vertical planning of site should cover reasonable planning of landform and terrain, determination of road control elevation and ground drainage planning. Where

gradient of natural landform is over 8%, the stage layout should be adopted at site and two adjacent stages should be connected by retaining wall or slope.

4.2 Site design

4.2.1 Site design includes preliminary design and shop drawing design.

4.2.2 Preliminary design should include technical plans, design drawings, functional index calculation of projects, list of major equipment and materials and project calculation, in which:

a) Technical plans include: Analysis on current status and demands; overall design, structure, function, communication and broadcasting, power supply, design of environmental adaptation, implementation plan and other design contents appointed.

b) Design drawings include: Design introduction, site plan, floor plan of building and internal layout and plan of setting signs and markings.

4.2.3 Design institute should design shop drawings according to preliminary design documents approved. Upon the completion of the project, the design institute should draw as-built drawings according to designed shop drawings, drawing review records and design changes.

4.2.4 Engineering drawings of site facilities should be prepared as per GB 50162 while other items should be in accordance with drawing standards of state or industry.

5 Test Site of Training

5.1 Set elements of site

Set elements of site should be divided in accordance with evaluation classification, vehicle type, requirements of automated vehicles to test and training site set out in T/CMAX 116-01-2018 *Contents and Methods of Field Test Capability Assessment for Automated Vehicle*.

5.1.1 **Road body**

5.1.1.1 **Road grade, length, designed driving speed and type of passable vehicles**

Road grade, length, designed driving speed and type of passable vehicles of site are as shown in Table 1:

Table 1 Requirements for Road Grade, Length, Designed Driving Speed and Type of Passable Vehicles

Road Grade	Capability Assessment Grade	Length (m)	Designed Driving Speed (km/h)	Type of Passable Vehicle
Main road of highway	T5	≥500	≥100	Minibus, medium bus, large bus, urban bus, minivan, medium truck and large truck
Entrance/exit, ramp and other parts of highway	T5	-	≥40	
Main road of express way	T5	≥500	≥80	
Entrance/exit and other parts of express way	T5	-	≥40	
Urban main road	T1	≥500	≥60	
Urban secondary trunk road	T1	≥500	≥50	
Urban branch road	T1	≥500	≥40	
Other urban roads	T1	-	≥40	

Class 4 road	T3	≥300	≥40	Minibus, medium bus, large bus, urban bus, minivan, medium truck and large truck
Substandard road	T3	≥300	≥40	Minibus, medium bus, minivan and medium truck

The items in table above should be designed as per JTG D80, JTG D81 and CJJ 37.

5.1.1.2 **Road type**

Requirements for types of roads at site are as shown in Table 2:

Table 2 Requirements for Road Types

Road Grade	Capability Assessment Grade	Detailed Requirements for Road Types
Main road of highway	T5	No less than 3 emergency lane and traffic lanes, including overtaking lane
Entrance/exit, ramp and other parts of highway	T5	Emergency lane, traffic lane
Main road of express way	T5	No less than 3 traffic lanes
Entrance/exit and other parts of express way	T5	No less than 1 traffic lane
Urban main road	T4	Reversible lane, right-turn lane, turn waiting area

Urban secondary trunk road	T3	Bus lane, main/auxiliary lane, non-motorized vehicle lane, vehicle/non-motor vehicle mixed lane
Urban branch road	T2	2-way 4-lane road and above
Class 4 road	T1	1-way 2-lane road and above
Substandard road	T3	2-way 2-lane road and above

The items in table above should be designed as per JTG D80, JTG D81 and CJJ 37.

5.1.1.3 **Intersection**

Requirements for types of road intersections are as shown in Table 3:

Table 3 Requirements for Intersection Types

Intersection Type	Capability Assessment Grade	Detailed Requirements
Intersection of highway/express way and highway/express way	T5	Intersection of highway/express way and highway/express way should be designed, if possible
Entrance/exit of highway, ordinary road/road	T5	Entrance/exit of highway, ordinary road/road
Entrance/exit of express way and urban road	T5	Entrance/exit of express way and urban road
Irregular intersection	T4	Irregular intersection with signal lamps and having 5 and above directions

Railway intersection	T4	Intersection of railway, urban road/ordinary road
Entrance/exit of main/auxiliary road	T3	Entrance/exit of main/auxiliary road
Interchange	T3	Grade intersection can be prepared to simulate 1/4 and above cloverleaf interchange
Island ring	T3	2-lane island ring with 5 and above entrances/exits
Cross intersection, T intersection, X or Y intersection	T4	Intersection containing turn waiting area, or canalized crossing
	T3	Intersection of 4-lane and above roads with signal lamps, and 2-lane and above roads; intersection n without signal lamp
	T1	Intersection of 2-lane roads and 2-way 2-lane roads with signal lamps; intersection of 2-way 2-lane roads with signal lamps and 1-way 1-2 lane roads
Sidewalk intersection	T1	Intersection of middle sidewalk of roads with signal lamps

The intersections above should be designed as per JTG D80, JTG D81 and CJJ 37 and give full considerations to the crossing between different roads.

5.1.1.4 **Road characteristics**

Requirements for road characteristics at site are as shown in Table 4:

Table 4 Requirements for Road Characteristics

Road Characteristics	Capability Assessment Grade	Detailed Requirements

Coverage characteristics	T5	Ponding pavement should be designed, with depth not less than 20cm and length not below 30m; at least 1 covered lane
Morphological characteristics	T4	Turn, continuous turn and sharp turn should be designed; radius of curve: 15m~40m
	T3	Ramp should be designed. Range of ramp gradient: 2%~10%; over 12% if possible
Shield characteristics	T4	Tunnel should be designed, with tunnel length not less than 100m
	T3	Avenue and roads near building should be designed, with length not less than 50m and 100m respectively for the former and the latter. Underbridge roads, such as simulated interchange and viaduct, should be designed, if possible
Material characteristics	T4	Asphalt pavement, concrete pavement and sand-gravel pavement should be designed, all with length not less than 100m. Pavement containing grate, cable cover and iron plate should be designed, with width not less than 30cm and 2m respectively for grate and iron plate; at least 1 covered lane

The items in table above should be designed as per JTG D80, JTG D81 and CJJ 37.

5.1.2 Auxiliary road facilities including traffic sign, traffic marking and traffic signal lamp

Requirements for traffic sign, traffic marking and traffic signal lamp are as shown in Table 5:

Table 5 Requirements for Traffic Sign, Traffic Marking and Traffic Signal Lamp

Traffic Sign, Traffic Marking and Traffic Signal Lamp		Capability Assessment Grade	Detailed Requirements
Traffic sign	Indication sign	T4	Signs for reversible lane and variable guide lane set out in GB 5768.2 should be designed
		T3	Marks such as turning set out in GB 5768.2 should be designed
		T2	Marks such as left turn, right turn, bus lane, left turn and U-turn set out in GB 5768.2 should be designed
		T1	Marks such as straight, straight and left turn, straight and right turn, keep right, keep left, one-way road, right turn lane and pedestrian crossing set out in GB 5768.2 should be designed
	Warning sign	T1	Marks such as watch for children and watch for pedestrian set out in GB 5768.2 should be designed
	Prohibition sign	T1	Marks such as no passing, no entry, no left turn, no right turn, no straight through, no U-turn, speed limit, stop to give way, slow down to give way, give way to oncoming vehicles set out in GB 5768.2 should be designed
	Guide sign	T1	Not specified. It can be set according to road conditions as per GB 5768.2

	Road construction safety sign	T1	All safety signs of road construction set out in GB 5768.2 should be designed
	Auxiliary sign	T1	Marks such as school and time range set out in GB 5768.2 should be designed
Traffic marking	Informative marking	T4	Left turn waiting area line and variable lane line set out in GB 5768.3 should be planned
		T1	Center line of 2-way 2-lane road, road boundary line, road edge line, pedestrian crossing and marking of parking lot set out in GB 5768.3 should be planned
	Prohibition marking	T1	Overtaking prohibition line, stop line, stop to give away line, slow down to give away line, guide line, mesh line and specific lane line set out in GB 5768.3 should be planned
	Warning marking	T1	Not specified. It can be set according to road conditions as per GB 5768.3
Traffic signal lamp		T4	Signal lamp at railway crossing set out in GB 14887 should be installed; such signal lamp can be enabled, if possible
		T3	Mobile traffic light, flash alarm signal and non-motor vehicle signal set out in GB 14887 should be installed
		T1	Motor vehicle signals, direction signals and crosswalk signals set out in GB 14887 should be installed.

Traffic signs should be installed according to road conditions as per GB 5768.2.

Traffic markings should be planned according to road conditions as per GB 5768.3.

Traffic signal lamps should be installed according to road conditions as per GB 14886. Types of traffic lights installed at one intersection can be different from those in other intersections.

5.1.3 **Traffic simulation facilities**

Requirements for traffic simulation facilities at site are as shown in Table 6:

Table 6 Requirements for Other Road Facilities

Facility Type	Capability Assessment Grade	Detailed Requirements
Facilities to simulate wet road	T5	Wet road should be built, with adhesion coefficient not above 0.3, length not below 50m, for the purpose of wet road test, training and capability assessment
Facilities to simulate rainy days	T5	Facilities to simulate rainy days should built, with length not less than 100m, capable of simulating (24h rainfall, unit: mm): Moderate rain (10.0~24.9), heavy rain (25.0~49.9), or simulate rainstorm (50.0~99.9) if possible, for the purpose of rain road test, training and capability assessment
Facilities to simulate foggy days	T5	Facilities to simulate foggy days should be built, with length not less than 100m, capable of simulating (visibility V, unit: mm): Heavy fog (500≤V<1,000), dense fog (200≤V<500), strong fog (50≤V<200), extra-heavy fog (V<50), for the purpose of road test, training and capability assessment in fog area

Facilities to simulate street lights at night	T5	Street light system should be built on most urban roads as per CJJ 45, including yellow and white lights, for the purpose of night driving test, training and capability assessment
Lighting simulation facilities	T5	If possible, lighting simulation facilities should be built, capable of simulating direct sunlight in the following range: Low light 200lx~1600lx and high light 20klx~30klx
Simulated charge station	T5	At least 1 simulated charge station should be built as per JTG D80 and JTG D81, including at least 2 two-way charge stations, simulated ETC toll gates and simulated manual toll gates
Simulated gas station	T5	At least 1 simulated gas station, 2 lanes and 1 refueling position should be built, see GB50156 for size design
Simulated charge station	T5	At least 1 simulated charge station and 1 parking lot should be built
Simulated highway service area	T5	At least 1 simulated highway service area should be built, including gas station, charging station and parking lot
Facilities to simulate streetscape	T4	Simulated streetscape should be built, with length not less than 100m and height not below 8m, for the purpose of network connection, communication and sight distance and shading test
Simulated parking lot	T4	At least 3 roadside parking lots should be installed at lateral sides of urban road; independent parking lots should be built, if possible

Facilities to simulate height limit rail	T4	At least 1 simulated height limit rail should be built
Facilities to simulate width limit	T4	At least 1 simulated width limit facility should be built
Simulated station for public bus and electric vehicle	T2	At least 1 simulated public bus and electric vehicle station should be built as per DB11/T 650
Road isolation facilities and safety facilities	T2	Soft/hard isolation facilities, such as guardrail, road barrier and greening belt, should be built according to road conditions; reflecting signs and anti-dazzle facilities should be built on highway
Speed bump	T2	At least 1 speed bump should be built

Facilities to simulate rainy days, foggy days, traffic marks and traffic marking in table above should be respectively arranged as per GB/T 28592-2012, GB/T 27964-2011, GB 5768.2 and GB 5768.3 based on the road conditions.

5.1.4 **Network connection and communication facilities**

5.1.4.1 Technical requirements for roadside equipment of network connection and communication

Network connection, communication protocol, performance, safety, interconnection and interoperation of roadside network connection and communication equipment at site should conform to:

a) China standard system: T/ITS 0013.3-2014 *Cooperative Intelligent Transportation Systems - Dedicated Short Range Communications*, 2015-1616T-YD *General Technical Requirements of Security for Vehicular Wireless Communication based on LTE*, 2016-1853T-YD *The Air Interface Technical Requirements of Vehicular Communication based on LTE*,

2018-0173T-YD *General Technical Requirements of Security for Vehicular Communication based on LTE*, 2018-1788T-YD *Technical Requirements of Vehicle Gateway based on Public Telecommunication Network*, 2018-0175T-YD *Technical Requirements for Vehicular Wireless Communication based on LTE – Technical Requirements for Roadside Equipment*, 2018-0174T-YD *Technical Requirements for Vehicular Wireless Communication based on LTE – Technical Requirements for Base Station Equipment*, C-ITS and T/CSAE group standard: 53-2016 *Cooperative Intelligent Transportation System; Vehicle Communication; Application Layer Specification and Data Exchange Standard*; *Test Specification for LTE-V2X Terminal Function, Performance and Interoperation* released by IMT-2020(5G) promotion group and C-V2X working group; or

b) USA standard system: SAE J2735, SAE J2945, IEEE 1609.3, IEEE 1609.4, IEEE 1609.2, IEEE 802.11P and etc.

5.1.4.2 **Deployment of roadside network connection and communication equipment**

Roadside network connection and communication equipment should be deployed reasonably according to road conditions and requirements for assessment of automated driving.

5.1.5 **High-precision positioning enhancement facilities**

5.1.5.1 **High-precision positioning differential signals**

High-precision positioning differential signals should be provided at site and:

a) Support Beidou and GPS standard differential signals;

b) Support RTK differential information;

c) Support multiple receiving modes, such as network.

Where site is covered by differential signals, differential base station can be established at site to send differential signals that satisfy the requirements above.

5.1.5.2 **Deployment of differential base station**

Differential base station should be selected and deployed in places:

c) With good geological conditions and stable point location;

d) With wide view and be free from obstacles with elevation angle over 10° around;

e) With no signal reflector around;

f) Where differential correction signals can be easily broadcast or transferred.

5.2 Site deployment and plane design

5.2.1 Plane layout of site

5.2.1.1 Design of function division of site

Function area of site should be divided according to traffic flow characteristics to avoid disturbance and hidden danger. Function division can be deployed as follows:

a) High-speed test area, including highway and auxiliary facilities;

b) Urban test area, including urban road and auxiliary facilities;

c) Rural test area, including urban/rural road, substandard road and auxiliary facilities.

The followings can be deployed, if possible:

a) Free test area, such as dynamic square;

b) Other independent test areas, such as parking lot and garbage.

5.2.1.2 Plane layout of site should be deployed according to function division, capacity of vehicles at site and expected hourly test/training times. Plan of test and training route should be prepared to naturally form test/training route of vehicle flow. Correctly organize flow of vehicles and pedestrians, and deploy the road auxiliary facilities and traffic flow simulation equipment reasonably. Horizontal alignment of site should be set fully considering the landform, geology and hydrology.

5.2.1.3 Well handle the engagement between straight line and curve line, set transition curve, ultrahigh and widened line as per JTG D80, JTG D81 and CJJ 37 while designing road plane and vertical section.

5.2.1.4 Marks and logs should be set according to driving speed of section and requirements of GB 5768.2 and GB 5768.3.

5.2.1.5 The area within 10m at outer side of urban roads is buffer zone, which should be free from other objects; if such objects are inevitable, make sure to separate them using soft partition, such as tire.

5.2.2 Sight distance

5.2.2.1 No obstacle which affects sight distance is allowed at site and at field of view at height of 1~2m.

5.2.2.2 Monitoring equipment should be installed at site to monitor test and training vehicles and site.

5.2.3 **Separation**

The site should be physically separated from outer space and bayonet facilities should be installed at the entrance/exit.

5.3 **Traffic flow simulation equipment at site**

Requirements for traffic flow simulation equipment at site are as shown in Table 7:

Table 7 Requirements for Traffic Flow Simulation Equipment

Equipment Type	Equipment Requirements
Simulated motor vehicle	At least 1 simulated minibus should be provided; simulated bus, minivan, tricycle and motorbike should be simulated, if possible
Simulated non-motor vehicle	At least 1 simulated bicycle should be provided; simulated electric vehicle should be provided, if possible
Simulated pedestrian and animal	At least 1 equipment to simulate adult, children and the elderly should be provided; equipment to simulate animals should be provided, if possible

Other temporary facilities and objects simulated	Construction area	Facilities to simulate construction area should be provided
	Obstacle	At least 5 simulated obstacles of road should be provided
	Traffic control and accident	Facilities to simulate mobile traffic control should be provided

6 Capability Assessment Site

6.1 General rules

Capability assessment site should be set according to vehicle type and assessment grade as per T/CMAX 116-01-2018 *Contents and Methods of Field Test Capability Assessment for Automated Vehicle*.

6.2 Basic setting of road body

Road body, road auxiliary facilities, traffic simulation facilities, network connection and communication facilities and high-precision positioning facilities at site of capability assessment should be set using existing facilities at site. The details are as follows:

6.2.1 Grade T1 capability assessment road

a) Straight road, 1-way 2-lane road and above;

b) Intersection and crosswalk containing signal lamps.

6.2.2 Grade T2 capability assessment road

a) Including roads conforming to Grade T1 capability assessment;

b) Roads with quarter turn and curve turn;

c) 2-way 4-lane road and above, including soft and hard partition facilities;

d) Including public bus and electric vehicle station or bus bay.

6.2.3 Grade T3 capability assessment road

a) Including roads conforming to Grade T2 capability assessment;

b) Including vehicle/no-motor vehicle mixed road, main and auxiliary road, rough road and avenue;

c) Including bus lane, bicycle lane and sidewalk;

d) 2-lane island ring with 5 and above entrances/exits, entrance/exist of main/auxiliary road, 2-way 4-lane and above roads installed with signal lamps, intersection of 2-lane and above roads and intersections without signal lamps.

e) Including simulated 1/4 and above cloverleaf interchange.

6.2.4 **Grade T4 capability assessment road**

a) Including roads conforming to Grade T3 capability assessment;

b) Including roads with turn ramp, sharp turn and continuous turn;

c) Including tunnel and reversible lane;

d) Including pavements with grate, iron plate and rail;

e) Including cement and gravel pavement;

f) Including irregular intersection with signal lamps and having 5 and above directions;

g) Including intersection with turn waiting area, canalized intersection and railway crossing;

h) Including roadside and site parking lot.

6.2.5 **Grade T5 capability assessment road**

a) Including roads conforming to Grade T4 capability assessment;

b) Including highway and urban expressway;

c) Including service area, toll station, charge station, width and height limit facilities;

d) Including wet, ponding and scattered pavement.

6.3 **Setting of capability assessment site**

6.3.1 Traffic sign, traffic marking, traffic signal lamp, traffic command gesture, emergency stop, operability after manual intervention, emergency handling, startup, following, lane change, straight crossing of intersection, crossing of sidewalk, turning

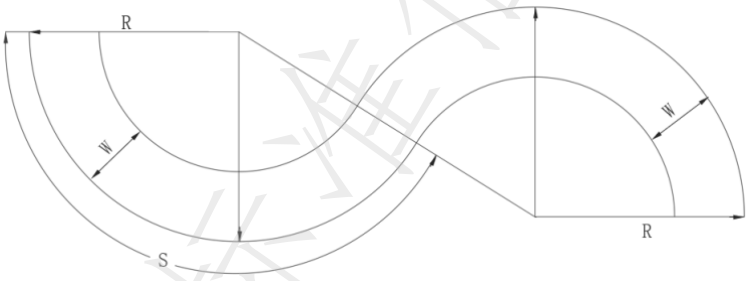
left at intersection, turning right at intersection, U-turn, roadside parking, cross public station, meeting, pass island ring, driving at main/auxiliary road, pass school area, overtaking, emergency evasion, variable guide lane and turn waiting area.

The specific assessment sites above should be set dynamically according to road conditions at site and not be fixed.

6.3.2 **Curve driving**

Graph of curve driving should be set according to Fig. 1.

Curve driving site should be set according to site conditions. Lanes at test and training site can be set according to graph, or be set according to dynamic mark, line and separation facilities at site.



R – Radius: 14m for large truck; 12m for medium truck, large bus and urban bus; 9.5m for minibus, minivan and medium bus;

W – Road width, see table below:

Parameters of large trucks are shown in table below:

Wheel base: L	L=5	5<L<6	6≤L<7	7≤L<8	L≥8
Road width: W	4.0	4.5	5.0	5.6	6.4

Parameters of medium truck, large truck and urban bus are as shown in table below:

Wheel base: L	L<4	4≤L<5	5≤L<6	6≤L<7	L≥7
Road width: W	3.7	4.2	4.7	5.4	6.2

Parameters of mini bus, minivan and medium bus are as shown in table below:

Wheel base: L	L<3	3≤L<4	4≤L<5	5≤L<6	L≥6
Road width: W	3.7	4.0	4.5	5.2	6.2

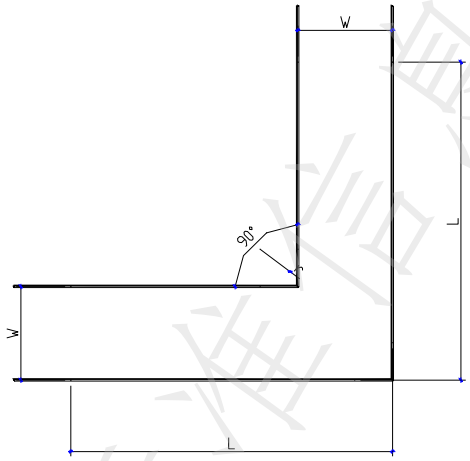
S – Arc length: Not less than 3/8 of circumference.

Fig. 1 Graph of Curve Driving

6.3.3 Right-angle curve driving

Graph of right-angle curve should be set according to Fig. 2.

Right-angle curve driving site should be set according to site conditions. Lanes at test and training site can be set according to graph, or be set according to dynamic mark, line and isolation facilities at site.



L – Road length: at least 1.5 times that of vehicle length;

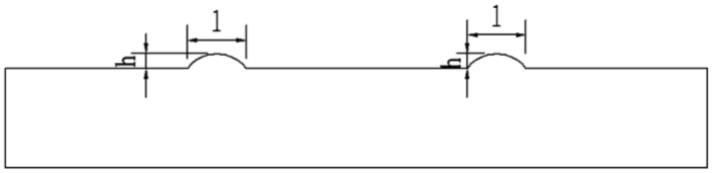
W – Road width: Wheel base is 1.2m for large bus, urban bus and large truck; 1.5m for medium bus and medium truck; 1.7m for mini bus and minivan.

Fig. 2 Graph of Right-angle Curve Driving

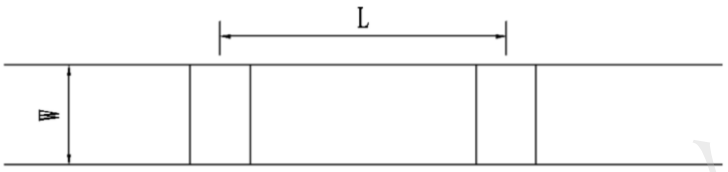
6.3.4 Dual-convex road driving

Graph and facility of dual-convex road driving should be set according to Fig. 3.

Site for dual-convex road driving should be deployed according to graph design of test and training site.



Sectional View



slope of ramp top slope of ramp

Top View

L – Length of ramp and spacing of convex road: over 12m for large bus, urban bus and large truck; over 9.0m for medium bus and medium truck; over 6.0m for mini bus and minivan;

h – Height of convex road: 0.06~0.12m;

W – Road width: ≥3.5m;

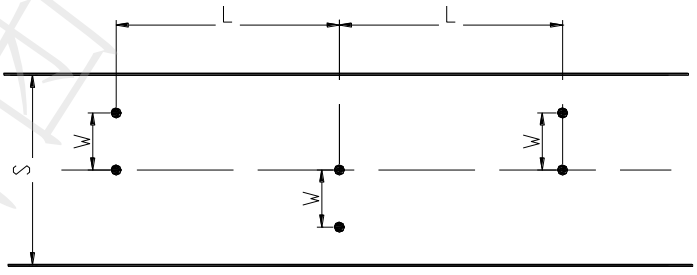
l – Length of convex road: 1.0m.

Fig. 3 Graph and Facility of Dual-convex Road Driving

6.3.5 **Width-limiting road driving**

Graph and facility for width-limiting road driving should be set according to Fig. 4.

Driving at width-limiting road should be deployed according to site condition. Lanes and facilities at test and training site can be set according to graph, or be set according to dynamic mark, line and isolation facilities at site.



- Width limiting facilities;

S – Road width: ≥ 7.0m;

W – Width of width-limiting road: 0.7m higher than vehicle width;

L – Fore-and-aft clearance of width-limiting facility, 3 times that of vehicle length.

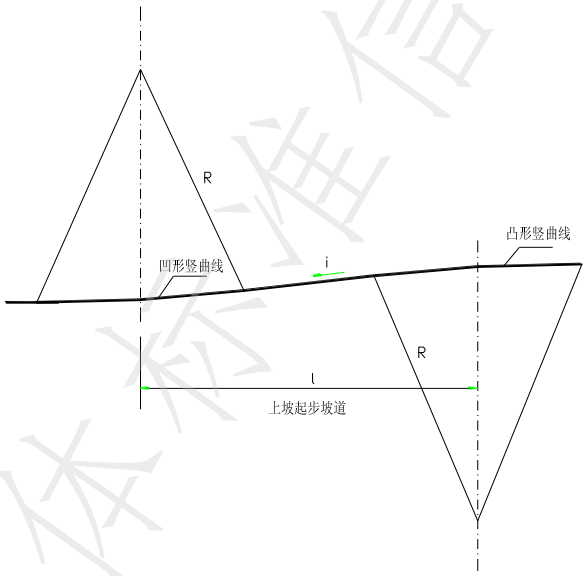
Fig. 4 Graph and Facility for Width-limiting Road Driving

6.3.6 **Narrow road U-turn**

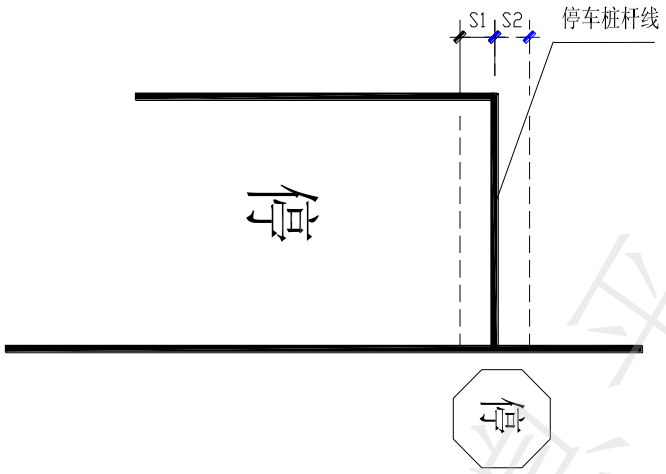
Length of narrow road U-turn is ≥20m and road width is 5.0m higher than wheel base; the lateral net clearance at vehicle driving direction is ≥2.0m, while lateral net clearance at reversing direction is ≥4.0m.

6.3.7 **Ramp parking and startup**

Graph and facility for ramp parking and startup should be set according to Fig. 5.



Sectional View



Top View

— - Parking pile line, with width of 0.3m;

i – Gradient: 10%;

l – Length of slope: ≥15m (including full length of curve);

R – Curve radius: ＞30m;

S1, S2 – Center distance from parking control line to parking pile line: 0.65m.

Fig. 5 Graph and Facility for Ramp Parking and Startup

Start point line, which should be single solid line of parking, should be set at the upper end of ramp.

The mark of "Stop to give way" and parking pile line should be set at the parking point of ramp. Parking control line, which should be set at both front and rear side of parking pile line, should be deployed at the position which is equivalent to vehicle length plus over 3.0m from ramp end and it should be located below the gentle slope of ramp top. Such mark line should be set as per GB 5768.2 and GB 5768.3.

6.3.8 Crossing of simulated cloverleaf interchange

Simulated 1/4 and above cloverleaf plane interchange should be built at test and training site.

6.3.9 Crossing of tunnel

It can be realized by simulated tunnel at test and training site.

If simulated tunnel is free from lighting, the daytime illuminance at the darkest place should be less than 50lx;

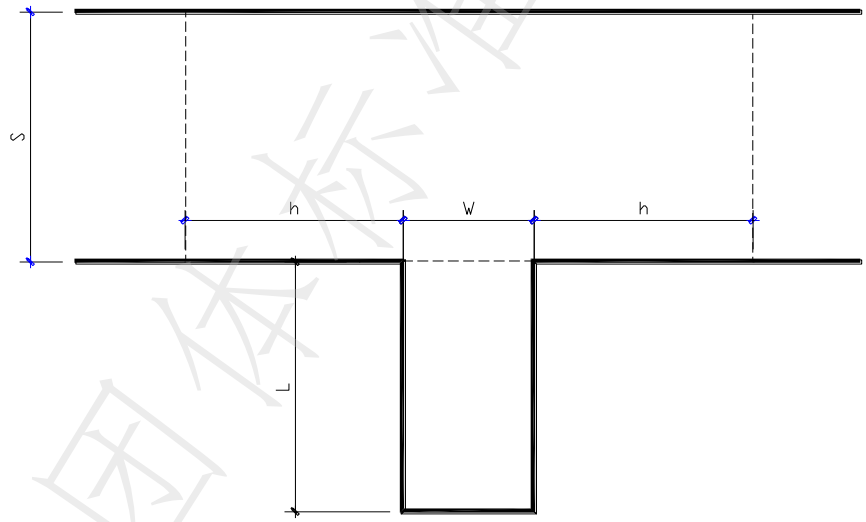
Length of straight road in simulated tunnel is ≥100m and inner clearance of simulated tunnel is ≥5.0m.

A mark to turn on headlight should be installed at the entrance/exit of simulated tunnel as per GB 5768.2.

6.3.10 **Reversal stall parking**

Graph of reversal stall parking should be set according to Fig .6.

Reversal stall parking should be deployed by measuring the actual stall at test and training site, or it can be realized by dynamic mark, line and isolation facilities at empty site.



W – Stall width: Vehicle width plus 0.6m;

L – Stall length: Vehicle length plus 0.7m;

S – Lane width: 1.5 times that of vehicle length;

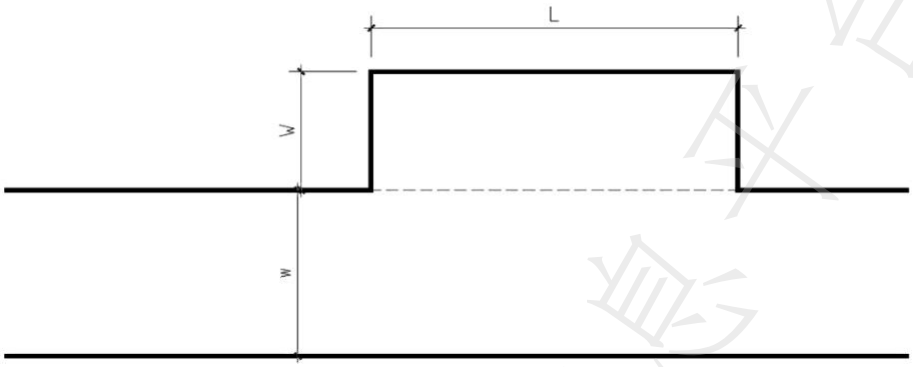
h – Distance from stall to control line: 1.5 times that of vehicle length.

Fig. 6 Graph for Parallel Parking

6.3.11 **Parallel parking**

Graph for parallel parking should be set according to Fig. 7.

Parallel parking should be deployed by measuring the actual stall at test and training site that is designed according graph, or it can be realized by dynamic mark, line and isolation facilities at empty site.



L – Length of parking space: 1.5 times that of length of large bus and urban bus minus 1.0m; 1.5 times that of length of mini bus and minivan plus 1.0m; 1.5 times that of vehicle length for other types of vehicles;

W – Width of parking space: Vehicle width plus 0.8m;

w – Lane width: 1.5 times that of vehicle width plus 0.8m.

Fig. 7 Graph of Parallel Parking

6.3.12 Crossing of road in rainy area

It can be realized through rainy day simulation facilities at test and training site.

The straight road installed with facilities to simulate rainy days should be ≥100m, in order to realize the effects of medium and heavy rain.

6.3.13 Crossing of road in foggy area

It can be realized through foggy day simulation facilities at test and training site.

The straight road installed with facilities to simulate foggy days should be ≥100m, in order to realize the effects of strong and ultra-heavy fog.

6.3.14 Crossing of wet road

It can be realized through simulated wet road at test and training site.

The simulated wet road should have adhesion coefficient not above 0.3, with length ≥50m, width ≥4m. Safety facilities should be installed at outer edge of simulated roads to well protect vehicles.

6.3.15 **Crossing of scattered road**

It can be realized through simulated scattered road at test and training site. Safety facilities should be installed at outer edge of simulated roads to well protect vehicles.

6.3.16 **Night driving**

A road which is covered by at least 350m street lamp system can be built at test and training site according to site conditions to realize night driving. Street lamps should be designed as per CJJ 45.

6.3.17 **Networked driving**

The site should be arranged according to actual road conditions at test and training site.

7 Site for Supporting Office and Service Facilities

7.1 Setting of site elements

7.1.1 **Elements of site**

The site should include office place for manufacturers: Vehicle debugging room and office environment; rest room should be provided, if possible; office place required by the site itself: reception center and monitoring center; office, office and rest room, machine room.

7.1.2 Vehicle debugging workshop should be equipped with lifter and tool kit.

7.2 Site layout and plane design

7.2.1 Layout of site should be arranged according to amount of manufacturers, volume of vehicles at site and number of office staffs.

7.2.2 Monitoring equipment should be installed at site to monitor test and training vehicles and site.

7.2.3 The site should be physically separated from outer space and bayonet facilities should be installed at the entrance/exit.

8 Site Infrastructure

8.1 Firefighting

Firefighting equipment should be installed at site and, if possible, emergency medicine and safety monitoring facilities should be prepared at site as per GB 50016.

8.2 Water supply/drainage

Complete water supply/drainage facilities should be installed at site to the satisfaction of office, living, greening and firefighting at site. Such facilities should be regularly maintained to ensure normal functioning of site facilities and protect foundation and pavement against damages due to ponding.

8.3 Power source and power supply

8.3.1 Power, which should be of AC voltage 220V or 380V and 3-phase 4-wire system, should be supplied by the substation nearby on basis of Class 3 load. UPS(Uninterrupted Power Supply) should be supplied to supporting office and service facilities and machine room at site. The general power distribution device should be installed in specific power distribution room.

8.3.2 General load and concentrated load should be respectively provided with trunk power distribution and radiation power distribution. The power cable from power source to power distribution device should be laid, while outdoor power cable should be buried.

8.3.3 The system should be provided with TN-S earthing protection. PE line should be used for connecting outdoor lamps. The protective metal tube for crossing cables and

the metal parts of lamps should be connected to PE. PE line should have the same section with phase line. Total equipotential device should be installed at the main power distribution device.

8.3.4 Lightning protection of buildings and structures at site should be designed as per GB 50057. High-pole lamps should be installed with lightning rod for protection and metal pole should be used as down lead. Each high-pole lamp should be installed with independent earthing device and such device should be connected to the crossing metal tube.

8.3.5 Lighting facilities should be set according to requirements of site. Road lighting at test site should be set according to Class III regulations in CJJ45, while lighting in other roads and sites should be set as per GB 50034.

8.4 Intelligent information system of site

8.4.1 Communication network system

8.4.1.1 Information receiving, storage, handling, exchange and transmission services should be effectively provided by communication network system to the owner (manager) and user of site.

8.4.1.2 Safety monitoring system, site traffic control system, site access/exit management system and site integrated control system should be set at site according to demands and regulations.

8.4.2 Weak current lightning protection system

Weak current lightning protection system, which should be designed as per GB 50343, should be set at site according to lightning protection requirements of buildings.

8.4.3 Generic cabling system

Generic cabling system, which can transmit the medium signals such as voice, data, image and monitoring and be designed as per GB 50311, should be adopted at site.