EXPRO
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National Manual of Assets and Facilities Management
Volume 6, Chapter 23

Maintenance Plan for Parking

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THIS NOTICE MUST ACCOMPANY EVERY COPY OF THIS DOCUMENT

IMPORTANT NOTICE

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1.0 PURPOSE

The purpose of this document is to provide an on-street and off-street, 'Parking Infrastructure' maintenance plan, containing principles, guidelines, and minimum requirements, for the maintenance, inspection, repair, and rehabilitation of the existing Parking Infrastructure, and offer guidance on best practices for the implementation of new facilities.

These are minimum requirements, applicable to both common and typical parking facilities. The Entity shall modify the requirements, specific to its own maintenance needs.

2.0 SCOPE

This document is applicable to both 'On-Street' and 'Off-Street', Parking Infrastructure asset/facilities.

2.1 On-Street Parking

On-street parking provides convenient, short-term parking, in close proximity to facilities, activities and destinations. On-street parking may be parallel, indented, angled, at kerbside, or in center-road islands. The street-type and pattern, determines the appropriate type of on-street parking to be used.

On-Street parking is generally located at, or near activity-centers, such as residential housing complexes, densely populated residential areas, train and bus stations, and high-street retail facilities. On-street parking is for the use of residents, visitors, businesses, and community facilities. Frequently, there are reserved bays for pick-up/set down areas, disabled bays, taxi ranks, bus stops, and loading zones.

2.2 Off-Street Parking

Off-Street parking facilities are generally built within urban centers, public and private institutions, residential and commercial developments, airports, hospitals, hotels, sports complexes, or near to main roads. These facilities are often operated by public agencies/private firms.

Typical Off-Street parking comprises:

- Roadside, surface, car-park
- Roof or basement car-parking, within a building
- Dedicated, multi-level car parks

This document applies to assets and facilities, for parking-related infrastructure, as follows:

- Parking Bays
- Wheel Stops
- Pavements
- Signage
- Line Markings
- Driveways
- Parking-Meters
- In-Ground Sensors
- Gate Barriers or Boom Gates
- Entry/Exit Stations
- Pay Stations
- Automatic Number-Plate Recognition Systems
- Parking, Guiding and Information Systems
- Rate Boards
- Variable Message Signs
- Central-Parking Management Systems
- Online Payment Platforms, Payment Gateways, and Mobile-Parking Apps
- Electric Vehicle (EV) Charging Stations
- CCTV Systems

Refer to National Manual of Assets and Facilities Management Volume 6: Maintenance Management for information related to maintenance of other building services asset such as electrical distribution, mechanical services, ventilation, lighting, lifts, etc in the car parking facility.

The maintenance requirements provided herein or cited by reference, are based on the Kingdom of Saudi Arabia's (KSA) Ministry of Transportation (MOT), United States (US) Department of Transportation, British Parking Association, Industry Standards, and best practices that should be embraced by the relevant Entity.

This document provides the minimum technical-requirements to be adopted by the Entity and/or Contractors to enable safety, quality, and cost effectiveness in the maintenance, repair, and rehabilitation of parking assets that meet the needs and expectations of the relevant Entity.

The Entity shall establish and develop set procedures for the continuous maintenance, care and performance efficiency of the Parking Facilities.

3.0 DEFINITIONS

Term	Definition
Automatic Number Plate Recognition	Provides automated entry/exit for preregistered vehicles
Asset Register	A group of information sources which permit a maintaining supplier to identify an engineering asset-base.
Boom Gates	Provide vehicular entry/exit through a controlled point
Detailed/In-depth Inspection	A close-up inspection, by one or more specialist members to identify any deficiencies in parking equipment that are not readily detectable using routine inspection procedures
Emergency Maintenance	Maintenance activity in a car parking asset/facility to rectify any hazards to the public
Electric Vehicle Charging Station	Provides an element in an infrastructure, that supplies electric energy for the recharging of plug-in electric vehicles, and plug-in hybrids
Inspection	The evaluation of the condition of an asset(s) through a formally defined and controlled process. The process shall include all relevant information, site inspection surveys, and analytical assessments, where required by this document or any other standard
Line Marking	Conveys certain regulations, warnings and guidance, to drivers
Maintenance	The undertaking of preventative and/or corrective action, including repairs, to ensure that the condition of the asset continues to meet the required duty, over the service life of the asset
Parking Guiding and Information System	Provides drivers with dynamic information on parking within controlled areas. Aids in the search of vacant, parking spaces by directing drivers to parking bays where occupancy levels are low
Parking Meters and Pay Stations	Facilitates the collection of cash and electronic payments in, exchange for the right to park a vehicle at a particular place, for a limited amount of time
Preventative Maintenance	A planned strategy of cost-effective treatments to an existing asset
Rehabilitation	Rehabilitation restores parking infrastructure to its usable condition, limits the deterioration and ensures public safety. It also includes addressing any defects, increasing the service life of the asset
Repair	Repair techniques are used to restore the damaged portion of the parking asset/facility, e.g., crack-filling of asphalt, touch-up painting of line markings, and/or rectifying a defect of a parking meter
Sealed Surface	Provides safe, driving conditions, and a uniformed road-surface. This minimizes the rate of deterioration of the parking lots

Service Life	The service life of an asset, element, or component is the total period during which the asset remains in use. Maintenance can extend service life of the asset
Strengthening and Renewal work	Strengthening and Renewal work is corrective action that addresses, life-expired assets or elements, in accordance with the supplier's program for lifecycle management, or a change in use, function or duty of the asset or element
Temporary Works	Site installations that are necessary for the progress of the work in safety, and that are not part of permanent works
VicRoads	Roads Corporation of Victoria: Australian State Government agency that owns, manages, and regulates the arterial road network, and provides vehicle registration and licensing services in State of Victoria
Visual Inspection	Close inspection of all components of the parking infrastructure, carried out within touching distance
Variable Message Signs	Provides information to drivers regarding the available parking spaces, directions, and status of cars parked
Wheel Stopper	Provide protection to pedestrians, vehicles, kerbs, and sidewalks
Acronyms	
ACR	Asset Condition Reporting
ANPR	Automatic Number Plate Recognition
CAPEX	Capital Expenditure
CMMS	Computerized Maintenance Management System
CPMS	Central Parking Management System
EV	Electric Vehicle
HSSE	Health, Safety, Security, and Environment
KSA	Kingdom of Saudi Arabia
MOF	Ministry of Finance
MOT	Ministry of Transportation
NMA&FM	National Manual of Assets and Facilities Management
PARCS	Parking Access and Revenue Control System
PGIS	Parking Guiding and Information System
US	United States
VMS	Variable Message Signs

4.0 REFERENCES

Maintenance, inspection, repair, and rehabilitation of all existing parking infrastructure assets/facilities shall be based upon the requirements of this section, industry standards, and best practices.

A listing of the references is as follows:

- British Parking Association: Liability for Car Park Maintenance
- Kingdom of Saudi Arabia Ministry of Transportation
- KSA Ministry of Municipal and Rural Affairs: MOMRA Construction Specifications MA 100-C-V1/1 and MA 100-D-V2/2.
- KSA Ministry of Municipal and Rural Affairs: MOMRA Roads and Building Systems
- National Manual of Assets and Facilities Management Volume 6 Chapter 4 Maintenance Plan Writers Guide.
- US Department of Transportation: Report No. FHWA-RD-99-168 / Sealing and Filling Cracks in Asphalt Pavements

5.0 RESPONSIBILITIES

5.1 The Entity

- The Entity and/or their appointed, specialized contractor, must comply with all applicable legislation, regulations, and other policies imposed by Federal and Local Government Authorities in KSA, while performing Operation and Maintenance works on parking infrastructure assets/facilities
- The Entity must ensure that all staff and suppliers carrying out operation and maintenance activities are competent to undertake their work
- The Entity and/or their appointed, specialized contractor shall have an organizational structure with adequate staff, with clear roles, responsibilities, and competencies, to effectively oversee and monitor the operation and maintenance activities, and works
- The Entity and/or their specialized contractors, shall have a competence management system in accordance with the published guidance and standards for operations and maintenance of the parking infrastructure assets/facilities
- The Entity and/or their specialized contractors, shall have training programs on developing and maintaining staff competence
- Inspections of assets shall be carried out by suitably experienced, competent, and qualified staff
- The Entity must ensure adequate funds are available to manage potential Health, Safety, Security, and Environment (HSSE) risks, arising from staff working on parking assets, and the public who are using the parking facilities
- Provide information to educate the public on the proper use of parking facilities, compliance requirements and avoiding vandalism

5.2 Parking Services Manager

- Responsible for implementing approved HSSE requirements by the Entity, and managing potential Health, Safety, Security, and Environment (HSSE) risks arising from staff working on parking assets, and/or the public, who are using the parking facilities
- Ensures the timely execution of preventative/corrective maintenance works to keep the parking assets in proper operational order at all times. This can be achieved by appointing approved specialized contractors, or be delivered by the Entity's in-house teams that are trained/certified to carry out required maintenance activities
- Ensures that services are delivered in compliance with the requirements defined in this document, and applicable volumes/chapters in National Manual of Assets and Facilities Management (NMA&FM)
- Distributes and displays informational materials to educate the public on proper use of parking facilities, compliance requirements and avoiding vandalism

5.3 Parking Attendants

- Modern car parks are often designed and built to operate unmanned, with fully-automated systems, supported by remote monitoring through a 24/7 integrated, customer-support center
- The Entity shall review each car park under their responsibility, and make necessary arrangements to connect the car park to a 24/7 customer-support center, or make necessary arrangements to deploy parking attendants to manage customer-support requirements locally

5.4 General Public

- Must comply with the regulations and published instructions within the Facility, and not damage or misuse the installed equipment & facilities

6.0 PROCESS

The comprehensive Parking Facility maintenance plan, shall employ actions and strategies to preserve the service life of parking control equipment and systems.

The Entity shall consider the following key-components in the maintenance plan, for the effective maintenance of the parking infrastructure asset/facilities:

- A CMMS to assist the Entity with recording all maintenance activity at the Facility
- An effective, planned maintenance program
- Inspection schedule (visual, detailed), and reporting
- Effective corrective maintenance
- Implement industry best practices with regard to repair and rehabilitation works
- Having suitably qualified and experienced workforce, providing technical devices, materials and equipment necessary for parking equipment maintenance

The Entity shall use a Computer Aided Facilities Management System (CAFM), or Computerized Maintenance Management System (CMMS), in order to manage the recording and closure of planned, reactive, and other maintenance activities. It is essential that this workflow accurately records all work activities over time, to enable the Entity to review the performance of elements of every Parking Facility.

Refer to National Manual of Assets and Facilities Management Volume 7: Work Control for more information

6.1 Safety

The Entity shall carry out maintenance works in ways that aim to ensure the safety of both workers and parking users, as well as minimizing delays and inconvenience to traffic.

Maximize the safety through a comprehensive review and analysis of safety data and the allocation of resources in planning and programming to support safety in parking maintenance activities.

Identify any safety gaps or opportunities where further work is needed to improve the safety of workers and parking users.

Minimum required safe clearance should be maintained when performing works near or under overhead power lines and permit-to-work should be obtain when required.

Ensure safe and timely restoration of operations of parking equipment after an incident.

Following health and safety aspects shall be considered while carrying out maintenance works at parking facilities:

- Working on roads.
- Working with chemicals & paint.
- Working on Electrical / Electronics.
- Working near railways & motorways.
- Working at heights.
- Working in confined spaces.
- Night works.

Refer to National Manual of Assets and Facilities Management Volume 10: Safety, Health and Environment

6.2 Maintenance Work

Public car parks and associated landscaping should be designed and built to achieve minimum maintenance requirements during their lifecycle. Maintenance work should be undertaken to ensure assets meet their designed life expectancy. Maintenance work shall be justified on the principles of whole lifecycle asset management, and may be preventative (planned), reactive, or requiring remedial action, including repairs to damages and defects.

The Entity should implement an appropriate maintenance strategy, incorporating periodic and scheduled visual inspections in order to:

- Ensure public safety
- Minimize the rate of degradation of their parking asset
- Sustain the functional requirements of each parking infrastructure feature
- Recognize and respond to the requirements of parking users

6.2.1 Planned Maintenance

The Entity/Contractor shall develop a frequency-based schedule of planned preventative maintenance activities, combined with regular inspections, to prevent deterioration of asphalt surface, line markings, fading of parking signs, cleanliness of the parking lots, and to ensure proper operation of Parking Access and Revenue Control System components. These include parking meters, ground sensors, boom gates, entry/exit gates, pay stations, Parking Guidance and Information System (PGIS), Automatic Number Plate Recognition System (ANPR), Central Parking Management System (CPMS), and all associated system controls.

These activities should maintain the usability of parking infrastructure assets/facilities. Planned preventative maintenance activities are classified into two groups: scheduled and response:

6.2.2 Unplanned Maintenance

The Entity/Contractor shall develop a reactive and emergency maintenance plan to cater to unscheduled and unplanned maintenance, such as that caused by vehicle impacts, sandstorms, rain, soil settlements, vandalism and fires, or to mitigate the consequences of other extreme events that may arise during the asset's life.

This is usually reported through a service call when a component or a system has been perceived to not be working appropriately, or is no longer fit for purpose. Where possible, this should be recorded against the asset number of the parking lot/equipment, to allow historical data to be collated.

The consequent inspection after the service call can result in two actions:

- If the problem is affecting the usability of parking infrastructure assets/facilities, or posing threat to the health & safety of public, then emergency response and corrective action is required immediately
- If the problem is not critical, then a routine, planned preventative maintenance response may be adequate

Refer to National Manual of Assets and Facilities Management Volume 7: Work Control for more information.

6.3 Inspection

The Entity shall develop a comprehensive parking infrastructure asset/facilities inspection program, according to the needs and usage of its operations, and record this information for subsequent use in identifying areas requiring investment to improve/remedy.

Prior to commencing site inspections, the Entity/Contractor shall ensure that the person undertaking the work is competent to carry out the inspection. The Inspector shall ensure that they have all the relevant documentation, inspection equipment and safety equipment, to carry out the inspection.

All staff involved in parking infrastructure assets/facilities inspections, must be familiar with their responsibilities under Health & Safety legislation, and RAMS shall be in place and reviewed as to their suitability at the time of the inspection. It is worth noting that a car park is a dynamic location and circumstances can change without notice. It may be necessary to undertake an additional Point of Work Risk Assessment (POWRA), prior to commencing work.

There are generally two types of inspection:

- General/Visual Inspection
- Detailed/In depth Inspection

Inspections of parking infrastructure shall be carried out for the following purposes:

- To confirm that parking assets are safe for use, for workers and members of the public
- To provide information necessary for the managed maintenance of parking facilities
- To provide the information necessary to assess the condition of the parking facilities in a consistent and accurate manner
- To provide information enabling the asset register to be maintained as an accurate record of the physical features of the assets
- To provide all the necessary physical information on assets, to meet the requirements for the Asset Condition Reporting (ACR) process
- To identify defects, the causes and effects of damage, and deterioration of parking facilities

The asset register for each parking facility shall be reviewed, and the records updated as a part of the reporting process. Reports shall be:

- Retained, preferably in an electronic format for the life of the asset
- Reviewed for action, upon receipt
- Reviewed by a competent person to ensure that issues identified in prior inspections have been resolved, or the associated hazards, mitigated

The Entity should inspect each parking facility at least monthly, with more detailed quarterly and annual inspections scheduled. The frequency of inspection, and the level of detail, should be determined by the Entity, and will be related to the usage of the parking facility. Attachment 3: EOM-ZMO-TP-000092 - Risk Management Checklist Template: Car Parks, may be used as a checklist and general guidance document in the preparation of site-specific inspections.

Refer to National Manual of Assets and Facilities Management Volume 5: Operations Management for more information.

6.3.1 Visual Inspection

The Entity/Contractor shall carry out visual inspection with the following considerations and purposes:

- Verifying the general serviceability of the parking infrastructure assets/facilities
- Identifying any emerging problems
- Ensure the safety of the public who are using the parking facility
- Identifying deficiencies to incorporate into the Asset Management Program/Computerized Maintenance Management System (CMMS) that would initiate maintenance activities and/or rehabilitation of the facility
- General inspections shall bring to notice any deterioration in condition, or a visible development of defects in particular asphalt surface, line markings, parking signs, footpaths and storm water drains within the parking facility, and any of the parking access and revenue control system components

- General inspections shall be of sufficient quality to detect and report any visual changes since the last inspection, or evidence of circumstances which may impact the condition of the asset before the next scheduled inspection

The Inspector shall collect the following minimum information:

- The general condition and appearance of the parking infrastructure assets/facilities
- Public safety hazards
- All damages, potholes, cracks, subsoil settlements, surface deteriorations, fading of line markings, paving damage, landscape damage, parking signs damage, graffiti and any defects, damages or malfunction of parking access and revenue control system components
- Take photographs of damage and/or safety hazards, for repairs

6.3.2 Visual Inspection Reports

The Visual Inspection Reports shall include, but not be limited to, the following:

- Cover page
- An extract of map coordinates, clearly showing the location of the parking lot
- As built drawings (if available), or sketches
- Record of the location, extent, and severity of all defects
- Photographs (general and defect)
- Recommended maintenance actions/needs and remedial work necessary, including the priority for such work
- Provide details of any emergency action required, to ensure public safety
- Confirmation, by signature and date, that the inspection has been fully completed

6.3.3 In-Depth Inspection Reports

The Entity/Contractor should carry out the detailed/in-depth inspection of the parking lot when:

- A general/visual inspection does not provide sufficient assessment to identify damage following an accident
- Major subsoil settlements
- Major asphalt surface cracks
- Operational failure of a major system or component
- Following a fire

6.3.4 Scope and Content

The Entity/Contractor shall perform an extensive inspection, to be carried out by qualified and competent personnel, to assess:

- Root cause of any structural damage to the parking asset, and the extent of that damage
- Integrity of the buried utility services in the parking facility
- Reliability of the parking access and revenue control system components and operating networks

Detailed Inspection Reports shall, consist of, but not be limited to:

- Detailed Inspection Cover Sheet (signed by the inspector)
- Executive Summary
- Introduction and Purpose
- Site Visit Details and Findings
- Photographs
- Conclusions
- Recommendations (remedial actions required)

6.4 Parking Infrastructure Repairs

Repair of parking infrastructure assets/facilities is usually required due to inadequate maintenance, excessive usage, and/or exposure to adverse environmental conditions. A regular inspection regime and completion of the necessary repairs and remedial activity, will extend the functional asset life of existing parking infrastructure. It is also an efficient and cost-effective procedure to maintain the serviceability of the facility.

6.4.1 Asphalt

Effective repair of asphalt surfaces and road base, wherever required, entails understanding the causes of deterioration, and an assessment of the effect of the repair on future asset life. This must be based on a good test of the existing surface wear and tear, road base deterioration, soil settlements, age of the asphalt, usage, and environmental effects.

The Entity shall appoint an approved specialized contractor to carry out crack treatment, surface treatment, and pothole patching and repair works.

Refer to National Manual of Assets and Facilities Management Volume 6 Chapter 13 Pavement Maintenance Plan for more information.

6.4.2 Line Markings and Parking Bay Numbers

All line markings and parking bay numbers shall be repaired/re-instated using the original paint materials. All solvent-borne or waterborne paints, thermoplastic materials, cold applied marking materials, marking tapes and reflective glass beads, must comply with original specifications, and should be pre-approved by the respective authorities.

6.4.3 Signpost/Board and Advisory Notices

All faded/discolored/damaged/defective traffic signs, parking advisory notices, digital signage, floor signage, glow bollards and convex mirrors, should be replaced with the originally installed sizes and specifications. All damaged signs shall have an incident report and must be replaced immediately.

Refer to National Manual of Assets and Facilities Management Volume 6 Chapter 13 Roadway Safety Barriers and Signage Maintenance Plan for more information.

6.4.4 Parking Meters and Ground Sensors

The Entity shall appoint approved specialized contractor/s to carry out the maintenance and repair works of parking meters and ground sensors, as required and in accordance with the original equipment manufacturer's recommendations or establish an in-house team with suitably qualified and experienced personnel trained by the original equipment manufacturer.

6.4.5 Parking Access and Revenue Control System

The Entity shall appoint approved specialized contractor/s to carry out the maintenance and repair works of parking access and revenue control system equipment. This includes pay stations, boom gates, entry/exit stations, PGIS, ANPR system, Variable Message Signs (VMS) and Rate boards, in accordance with the original equipment manufacturer's recommendations, or establish an in-house team with suitably qualified and experienced personnel trained by the original equipment manufacturer.

6.4.6 Electric Vehicle (EV) Charging Stations

The Entity shall appoint approved specialized contractor/s to carry out the maintenance and repair works of EV charging stations, in accordance with the original equipment manufacturer's recommendations, or

establish an in-house team with suitably qualified and experienced personnel trained by the original equipment manufacturer.

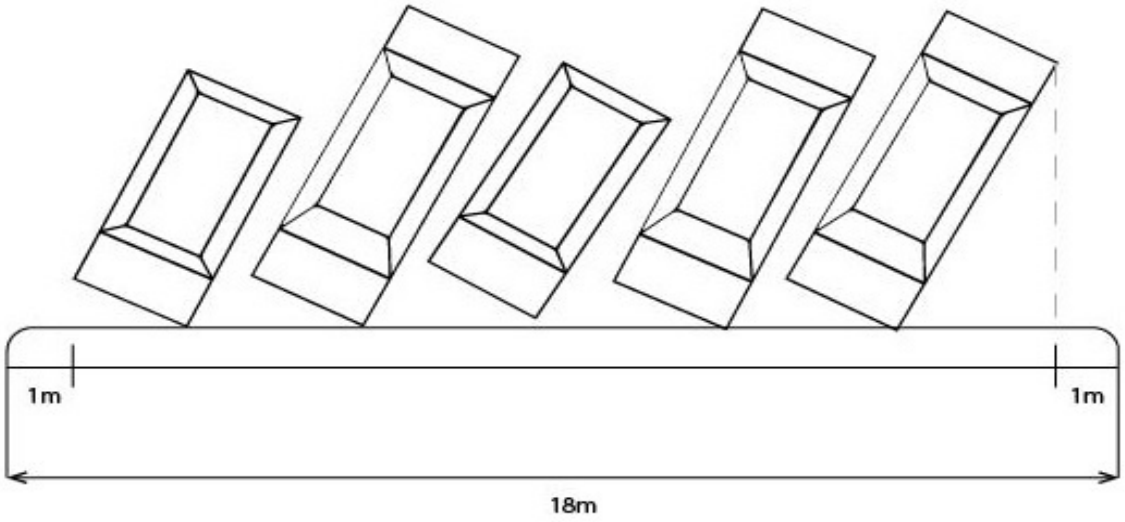
7.0 ATTACHMENTS

1. Attachment 1 Angled Parking Example
2. Attachment 2 90° Parking Example
3. Attachment 3 EOM-ZM0-TP-000092 - Risk Management Checklist Template: Car Parks

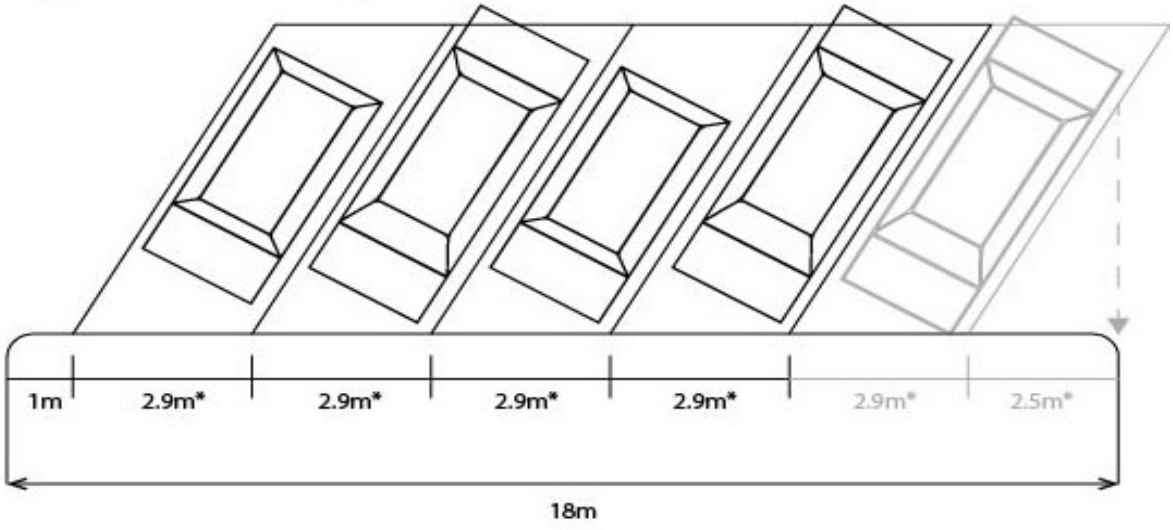
Attachment 1: Angled Parking Example

In an area with angled parking, marked bays may or may not fully fit within a length of kerb. In some cases, it may not optimize the available space and may lead to illegal parking behavior in areas with high parking demand. The 1st picture below illustrates importance of line marking, and the 2nd picture below demonstrates the improved parking alignment when line marking is used.

Unmarked angled parking



Example of 60 degree marked bays



*Dimensions may vary depending on the angle, turnover, kerb height or other environmental factors.

Figure 1: Angled Parking Example

Attachment 2: Ninety Degree (90°) Parking Example

In an area with 90° parking, the 1st picture below shows vehicles are parked in an unmarked 90° parking. This has an increased risk of the vehicles having an accident with the adjacent car. The 2nd picture below shows marked bays that provide the vehicles with a sight of alignment.

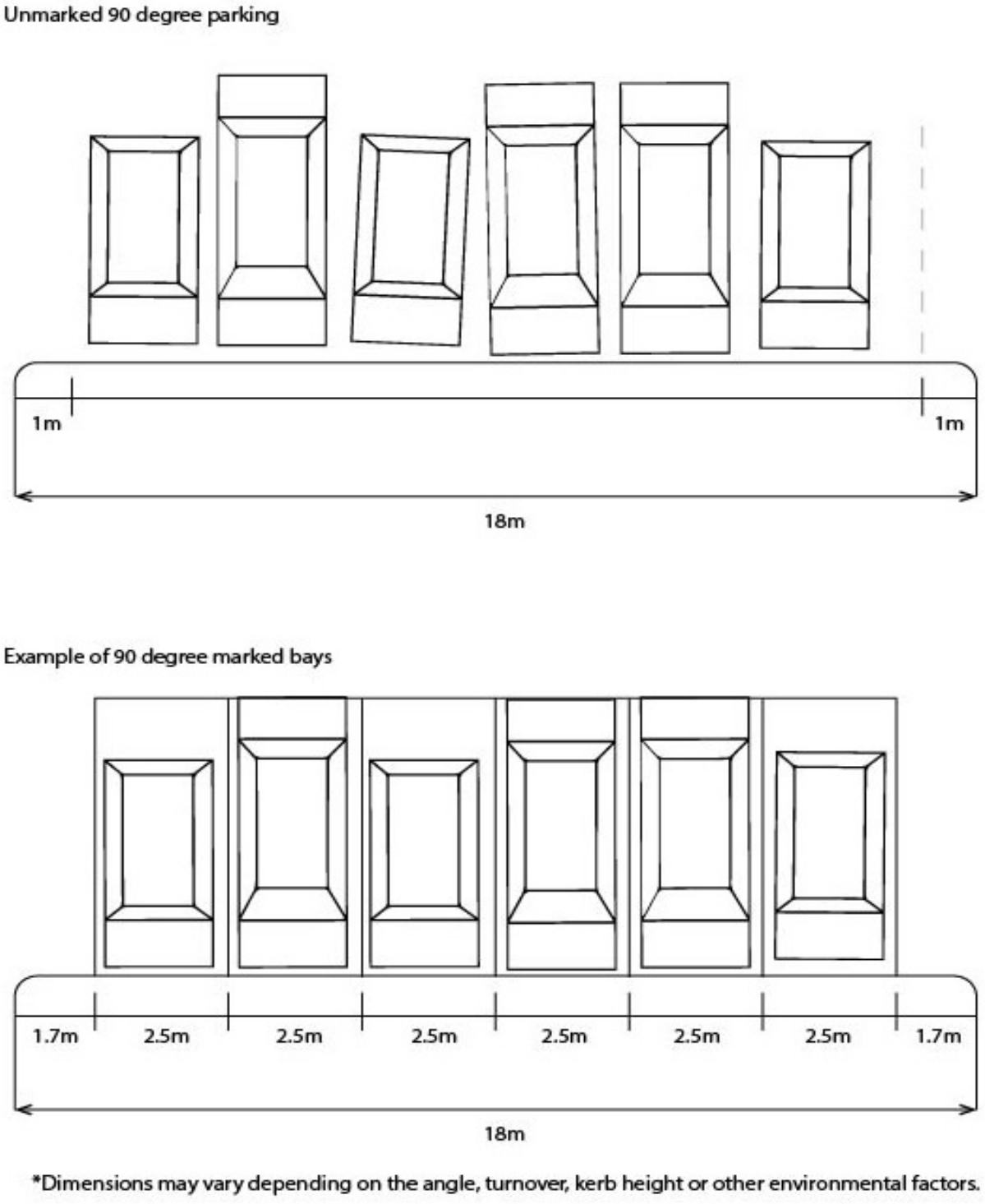


Figure 2: 90° Parking Example

Attachment 3: EOM-ZM0-TP-000092 – Risk Management Checklist Template: Car Parks

This checklist can do no more than provide a starting point for Entity/Contractor to use in the development of their own specific risk management checklists.

Assessment date ……/……/…… by [name of Risk Management Officer] ……

Description	Yes/No	Risk Rating H, M, L, N	Recommended Action	Responsibility	Rectification works scheduled on	Completed (signed off)
Is the car park and the surrounding area adequately lit?						
Is the car park and all parking control equipment clean and tidy?						
Is the entrance and exit area clear and free of obstructions?						
Is there adequate access for emergency vehicles?						
Are parking spots clearly marked?						
Are car parking rules & safety notices displayed properly?						
Is signage visible and able to be seen at night?						
Are shrubs and trees, where available, trimmed to minimize risk of physical injury and ensure maximum visibility?						
Are surfaces well maintained and free of oil?						
Are there sufficient notices displayed to indicate allocated spaces for people with disabilities?						
Are all parking meters in proper operational order?						
Are all pay stations in proper operational order?						
Is the PGI System in proper operational order?						
Are all boom gates in proper operational order?						

Are all entry/exit machines in proper operational order?						
Is the ANPR system in proper operational order?						
Is the car park fully occupied? Is there any demand for additional car parking spaces?						

Risk Rating **Description**

H – High
- Death or major injuries
- Revenue loss
- Closure of the parking facility

M - Medium
- Minor injuries or accidents
- Malfunction of a system component affecting the closure of one lane or part of the facility

L – Low
- Aesthetic and general appearance

None
- No risk