Engineering Solutions for Fire Truck Access

By:

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Outline

- International Fire Code (IFC) and Aerial Fire Apparatus Requirements

- Case Studies:
  - King Abdullah University of Science & Technology
  - Al-Midra Office Tower
  - King Abdulaziz Center for World Culture
  - Marine Loading Terminals
International Fire Code (IFC) and Aerial Fire Apparatus Requirements

Definition of Fire Truck Access Road:

“A road that provides fire apparatus access from a fire station to a facility or building. This term is inclusive of all other terms such as fire lane, Public Street, Private Street, parking lot lane and access roadway.” IFC 2006, 502.1

References:

- International Fire Code 2006 (IFC)

Standard Requirements (for high rise buildings):

Width of the access roads:

For buildings more than 30 feet (9.144m) in height, the access roads shall have a minimum of unobstructed width of 26 feet (7.925m).

No Parking Sign:

"No Parking Fire Lane" signs are to be provided at prescribed locations, IFC 503.3.

Minimum Height: 4.1 m

Minimum Load Capacity: 7.9m

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Turning Radius: It depends on the area fire apparatus being used.

**Figure 1: Example of Turning Radius for Ladder Fire Apparatus.**

In Figure 1 above, it must be taken into consideration the minimum inside turning radius and the bumper swing clearance. No obstructions such as fire hydrants shall be located on the bumper swing clearance to avoid any collision when turning. It is accepted to design roads within the minimum inside radius limitation given that the bumper swing is clear and the curb height is below the bumper height.

**Importance of Road Loading Capacity**

- When designing fire trucks, special consideration and calculations must be done on the road and soil.

- This is by comparing Vehicle Cone Index (VCI) to the Soil Index (RCI)

- VCI: Minimum strength of the soil critical layer that permits the vehicle to pass on it.

- Soil Index: usually referred to as Rating Cone Index (RCI).

- If VCI < RCI, then the vehicle will plow through.
Dead-end Access Roads:

Some access roads at this project are classified as dead-end fire apparatus access roads. Therefore, Table 1 shown below specifies the turnaround provisions in accordance with Table D103.4 from the IFC. This is because when a fire truck enters a dead-end road, it should park facing the escape route just in case sudden evacuation is needed the truck will escape forward as it is not allowed for the truck to reverse at long dead-end roads.

<table>
<thead>
<tr>
<th>LENGTH (feet)</th>
<th>WIDTH (feet)</th>
<th>TURNAROUNDS REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–150</td>
<td>20</td>
<td>None required</td>
</tr>
<tr>
<td>151–500</td>
<td>20</td>
<td>120-foot Hammerhead, 60-foot “Y” or 96-foot-diameter cul-de-sac in accordance with Figure D103.1</td>
</tr>
<tr>
<td>501–750</td>
<td>26</td>
<td>120-foot Hammerhead, 60-foot “Y” or 96-foot-diameter cul-de-sac in accordance with Figure D103.1</td>
</tr>
<tr>
<td>Over 750</td>
<td>Special approval required</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Requirements for Dead-end Fire Apparatus Access Roads, IFC 2006

Figure 2: Dead End Fire Apparatus Access Road Turnaround, IFC 2006
Proximity to building:

The access route should be located within a minimum of 15 feet (4.572m) and a maximum of 30 feet (9.144m) from the building.

**Figure 3: 39m Turntable Ladder Envelope**

The figure above shows the width of the truck with extenders is about 5 meters, and the maximum angle for the ladder is 75 degrees, and to reach an altitude of 39 meters the truck needs to be about 6 meters away from the building. The black dots in the figure shows number of persons that the ladder can carry at one time.
Case Study # 1

King Abdullah University of Science and Technology

Figure 4: University Campus Access Roads
Findings Related to Buildings 2 & 3

Fire Truck Accessibility:

The fire apparatus access road in front of these buildings is all made from grass concrete which is a great solution if the need to maintain a green area is required. This access road is not straight, at the middle of the road there is a 90 degree bend with palm trees on the side and immediately after that there is another 90 degree turn with palm trees on the side. The two bends are shown in the below figure.

![Figure 5: Previous Situation of Access Road at Bldgs# 2 & 3](image)

The access road is covering buildings 2 & 3. The access road is about 149 meters. Therefore, a turnaround is required. However, because the heights of the buildings are 41 meters which is more than 30 feet (9.2 meters), the width of the road shall be 26 feet. The actual width of the road is about 6 meters wide. The distance from the road to the building is (0 meters).

Findings related to Building 14 & 18

Fire Truck Accessibility:

The fire truck access is on one whole side of the building. However, the distances to the buildings are more than 20 meters. That exceeds the maximum allowed distance between the road and the building of 9.2 meters. The width of the road is 6 meters, which should be 7.9 meters.
Findings related to Buildings 4 and 5

Fire Truck Accessibility:

The access road is made from grass concrete. The access road is a dead-end type with a length of 149 meters. Therefore, a turnaround is required. However, because the heights of the buildings are 41 meters which is more than 30 feet, the width of the road shall be 26 feet. The actual width of the road is about 6 meters wide. The distance from the road to the building is (0 meters).
Case Study # 2

Al-Midra Tower, Dhahran, Saudi Arabia

Figure 8: Central Access Road and East + West Wing Access Roads
Findings Related to East and West Wings:

Figure 8 shows the two access roads serving the West Wing, W1 & W2. The length of the dead-end roads of W1 & W2 is over 90 meters. The dimensions of the island at the end of the dead-end road are not according to the requirements of Table D103.1 of IFC 2006. Furthermore, because the heights of the buildings are more than 30 feet (9.2 meters), the width of the road as per IFC should be 26 feet (7.925m). The actual width of the road leading to the building is about 6 meters wide. Moreover, the entrance to this road is very narrow and must be widened.

Solutions Provided:

- The width of the road was extended to 8.0 meters wide.
- At the end of the dead-end roads, a turnaround provision was constructed.

Findings Related Central Access Road:

Fire Truck Accessibility:

The central access road in the main entrance does not allow the aerial platform truck to set up the out riggers at or on the turning circle. The road width has to be widened at the turning roundabout to enable parking of the vehicle and set up of the truck out riggers. The roundabout shall have extended width, particularly at the building side to enable the truck to position within 5 to 10 m (15 to 30 feet) maximum from building proximity to enable maximum vertical reach.
Before and After Pics
Case Study # 3

King Abdulaziz Center for World Culture, Dhahran, Saudi Arabia

The Center is being constructed atop the oil-rich Dammam Dome, making it both a national landmark that commemorates Saudi Arabia’s first discovery of oil and a leading educational and cultural institution. Housed in an iconic building that is itself a work of art, the Center will offer a world-class museum, public library, historical archives, children’s educational center, conference and performance facilities and more. It will be the highlight of Saudi Aramco Cultural Park, which will also include a major community-oriented oil museum and corporate conference facilities.

The fire truck access design for this building is a good example of proper engineering during design stage to avoid later issues during startup.

Each building has its own dedicated access road leading to the fire department connection with fire hydrants close by.
Case Study # 4

Marine Loading Terminals at Yanbu Refinery, Saudi Arabia

Figure: Marine Terminal, NGL Loading Terminal, Crude Oil Loading Terminal

In this study, the focus will be on the Marine Terminal and NGL Loading Terminal.
The marine terminal is designed properly as shown in the below pictures. The roads are 26 feet wide, and they are designed to allow free flow of vehicle without the need to turnaround at the end of each road.
On the other hand, the NGL loading terminal shown below has a very narrow road that can barely be accessible by a regular sedan car.
Solution for narrow roads:

- Fire & Emergency Vehicle with:
  - Small wheel base
  - Small chase
  - Small turning radius.
  - Loops/hammerheads in the middle (if possible)

- Why it’s needed?
  - Rescuing Operations.
  - Initial Fire Fighting.
Conclusion:

- Facilities without fire apparatus access cannot be extinguished.
- Should be a priority item from the design stage.
- If omitted from the design stage, major delays in project + cost.