

## 4. M621 JUNCTION 2 ROUNDABOUT GEOMETRY

ISSUED as document HE551464-BWB-HGN-XX-RP-CH-002-S0-P1. The final version will be contained within the design strategy record (DSR).

4.1 The recent publication of DMRB CD116<sup>1</sup>, replacing TD16<sup>2</sup>, was a significant change to the design of signalised roundabouts (which were previously covered by TD50<sup>3</sup>). The change was that signalised roundabouts are to comply with the geometric standards for normal roundabouts. In particular the following parameters are mandatory:

- Entry widths and lane widths on entry;
- Visibility (except it is noted that circulatory visibility is not mandatory, as HE have confirmed that CD116 para 3.49.2 overrides para 2.5);
- Entry path curvature; and
- Circulatory carriageway width.

4.2 This change results in various issues for signalised roundabouts such as:

- The entry and exit arms for signalised roundabouts are frequently separated to maximise capacity as the storage on the internal links is critical to the design, which can be compromised by the need for entry path deflection;
- The circulatory widths and number of lanes on a signalised roundabout will often vary to match traffic flows, and they will frequently not be between 1 and 1.2 times the maximum entry width;
- Visibility to the right at and before the entry can frequently be obstructed by features such as bridge piers and parapets.

4.3 The assessment below of the roundabout geometry covers the key aspects, departures and decisions made. It does not provide a line by line assessment of all aspects of geometry as unless otherwise noted they are in line with the design standard.

4.4 The overall layout from a capacity perspective is assessed using microsimulation modelling and is covered in a separate report (ref to be confirmed in due course).

### Segregated left turn lane (SLTL)

4.5 A SLTL is proposed from the M621 eastbound slip road to the A643 northbound. An assessment of flows has been made based on CD116 para 6.1 and the decision process in Appendix C. The peak weekday flows (from the 2036 Do Something Core model) are presented as follows:

Location	AM	IP	PM
Left turning flow (vph) (L)	546	788	684
Total entry arm flow (vph) (F)	1069	936	701
Number of lanes (E)	3	3	3

<sup>1</sup> DMRB CD 116 "The geometric design of roundabouts", Revision 1

<sup>2</sup> DMRB TD 16/07 "The geometric design of roundabouts"

<sup>3</sup> DMRB TD 50/04 "The Geometric Layout of Signal-Controlled Junctions and Signalised Roundabouts"

Location	AM	IP	PM
F / E	356	312	234
Is L > (F / E) ?	Yes	Yes	Yes

- 4.6 Based on the above a SLTL is merited and due to the following factors a physical island will be provided:
- A pedestrian or cyclist crossing point is not required;
  - The junction is lit; and
  - All arms of the junction will be signal controlled.
- 4.7 The layout on the M621 eastbound slip road was reviewed from the preliminary design where it showed that the SLTL is developed as a taper from two lanes which then go to the roundabout stop line. Given the majority flow on the slip road is turning left it is appropriate for Lane 1 on the slip road to directly feed the SLTL as a dedicated lane (as Figure 6.27N2b). **The microsimulation assessment will be undertaken to confirm that this does not affect the capacity of the signalised part of this slip road.**
- 4.8 The average downhill gradient of the slip road is approximately 2.9% which is below the 4% requirement in CD116 para 6.28.
- 4.9 The geometry of the SLTL conforms to CD116, but the end taper has been elongated beyond the minimum 1:15 taper to a 1:23 taper, which is to maximise the ability for traffic to merge onto the A643 and minimise the risk of it acting as a give-way.
- 4.10 The visibility on the SLTL is the lesser of that derived from CD116 Table 6.27 and the visibility on the approach based on the design speed. The slip road design speed is 60kph which requires a forward visibility of 90m. Table 6.27 also requires a 90m visibility splay based on the maximum kerb radius of 77m. Hence a 90m forward visibility is provided along the SLTL.

**Decision 4-1:** A SLTL should be provided on the M621 eastbound slip road to the A643 northbound, with a dedicated approach lane and the end taper extended.

### Entry path curvature (EPC)

- 4.11 Entry path curvature (EPC) is greater than 100m on all four approaches, this is due to the following factors:
- For the two M621 slip road approaches, the existing slip road alignments and constraints imposed by the M621 mainline and adjacent land boundaries.
  - For the A643 approaches, it is important to maximise capacity by separating the entry and exit arms to allow sufficient stacking to be provided on the circulatory carriageway.
- 4.12 CD116 para 3.26.2 recommends that alterations to the central island to improve deflection are carried out. However, this is not possible without detriment to capacity or requiring significant reconstruction work to the junction such as replacing the M621 bridges.

4.13 CD116 para 3.26.3 recommends that subsidiary deflection islands (SDIs) are considered to improve entry path deflection. SDIs could, on a signalised roundabout, result in confusion where drivers could pass either side of the SDI to reach the same destination. They do, however, have a benefit where drivers would proceed to different destinations. Based on this, for J2, it is only the M621 westbound slip road approach where an SDI could be provided. However, there is insufficient carriageway width to do so. Hence no SDIs are proposed for the scheme.

4.14 CD116 para 3.26.4 does note that signalisation may be beneficial, and this is clearly proposed on this scheme for all arms.

4.15 The proposals for EPC are summarised as follows:

Approach arm	Proposed EPC (m)	No. lanes and lane splits	Consideration of SDI	Other mitigation	Departure reference
M621 westbound slip (HE network)	429	<b>3</b> L1: A643 S L2 & L3: A643 N	Could be used between L1 and L2 but there is insufficient space	Full time signalisation	<b>G16</b>
M621 eastbound slip (HE network)	245	<b>2</b> (excluding SLTL) L1 & L2: A643 S	Not appropriate due to both lanes for A643 S	Full time signalisation	<b>G17</b>
A643 southbound (LCC network)	132	<b>3</b> L1: M621 E L2: M621 E, A643 S L3: A643 S, M621 W	Not appropriate due to lane allocations	Full time signalisation	<b>GL01</b>
A643 northbound (LCC network)	115	<b>2</b> L1: M621 W, A643 N L2: A643 N, M621 E	Not appropriate due to lane allocations	Full time signalisation	<b>GL02</b>

**Decision 4-2:** Entry path curvature should be implemented in line with the above assessment and departure approvals obtained.

### Circulatory width

4.16 The width of the circulatory carriageway varies between 10.95m (under the two existing bridges) and 17.1m (on the south side between the A643 exit and entry arms). The maximum entry width is 11.6m on the A643 southbound approach. The circulatory width clearly varies from being less than the maximum entry width, to being 1.5 times the maximum entry width. This is departure from standard **GL03**. The circulatory width varies due to the following factors:

- The constraints imposed by the two M621 overbridges; and
- The need to maximise capacity on the south side of the roundabout, which has the heaviest flows as it is where flows from the A643 SB to M621 WB, and M621 WB to A643 NB combine.

4.17 The reduction in width between the A643 SB and downstream circulatory carriageway width is not a concern as only two lanes from the A643 SB feed into this section of the circulatory.

- 4.18 At the south side if the circulatory width was limited to 1.2 times the maximum entry width, i.e. 13.92m, then either:
- Only three lanes would be provided which would result in a significant reduction in capacity; or
  - Four lanes of 3.5m would be provide which due to the radius of approximately 55m would reduce capacity, lead to regular overrun by large vehicles, rapid deterioration of markings and could result in side-swipe accidents.
- 4.19 Based on the above it is justifiable for this section of the circulatory carriageway to be 1.5 times the maximum entry width.

**Decision 4-3:** The circulatory width should vary from below the maximum entry width at the bridges, and up to 1.5 times the maximum entry width on the south side of the roundabout, for the justifiable reasons set out above and a departure approval should be obtained.

### Visibility

- 4.20 Visibility to the right is not provided in line with CD116 at 15m from the ICD for both of the M621 slip road approaches. This is because the visibility is obscured by the bridge piers. This is one of the recent changes to CD116 and as the approached is signalised the need for visibility to the right from 15m back is greatly reduced (and in fact there is no give way line for the 15m distance to be measured from). Based on discussion with Highways England SES team it has been confirmed that it is not the intention for full time signalised approaches to have to comply with the visibility to the right requirements and this will be amended in a future revision of CD116. Hence no departure from standard is necessary.
- 4.21 The circulatory visibility is restricted to 45m by the bridge piers and the need to protect these piers with a vehicle restraint system (VRS). This is a relaxation as 70m should be provided. To provide 70m on the southern part of the roundabout requires significant earthworks and tree removal and hence a distance of 50m (one step below based on Table 3.43) is to be used, reducing to 45m at the bridges. This balances the need for visibility with minimising the environmental impact.
- 4.22 The scheme proposals comply with CD116 for signal intervisibility and, with the exception of the A643 northbound, all external approaches have clear visibility to at least one primary signal head associated with the particular movement. For the internal approaches the circulatory visibility of 70m is achieved to at least one primary signal head.
- 4.23 The visibility to the primary signal head on the A643 northbound is restricted due to the land constraints on the inside of the bend on the approach to the stop line. This is an existing issue and will not be made worse by the scheme, but is assessed under departure from standard **GL04**. Mitigation measures will include vegetation trimming to maximise visibility, increased skid resistance and providing a tall signal pole with primary repeater head on the offside.

**Decision 4-4:** The visibility proposals are appropriate and risks are minimised, with a departure approval obtained for the A643 NB approach. No departure from

standard is required for the layout not achieving visibility to the right at 15m from the ICD on the slip roads.

### **M621 slip merge roads: roundabout exits**

- 4.24 At both exits from the roundabout onto the M621 slip roads, merges are proposed to reduce the width from two lanes to one.

#### Eastbound merge slip road

- 4.25 The eastbound merge slip road has a slip road lane reduction taper, this is assessed in the section on grade separated junctions. This is required to encourage the use of two lanes from the A643 SB to M621 EB for capacity reasons.

#### Westbound merge slip road

- 4.26 As for the eastbound merge slip road it is important for the westbound merge slip road to have a two-lane exit and then reducing to one lane before the merge onto the M621 mainline. However, the westbound slip road is shorter than the eastbound and applying a slip road lane reduction taper would provide almost the same geometric alignment as providing a width reduction to CD116 paras 3.28.4 & 3.28.5. Two 3.95m lanes would exit the roundabout, followed by a 1:21 taper. It can be difficult for vehicles to merge on a bend and hence a 3m offside lane width is maintained until such time as the alignment straightens.

**Decision 4-5:** Two lane exits should be provided onto both M621 slip roads, the eastbound slip road should have a lane reduction taper as there is sufficient length to provide this, and the westbound slip road should follow CD116 but with merging encouraged to take place once the alignment has straightened.