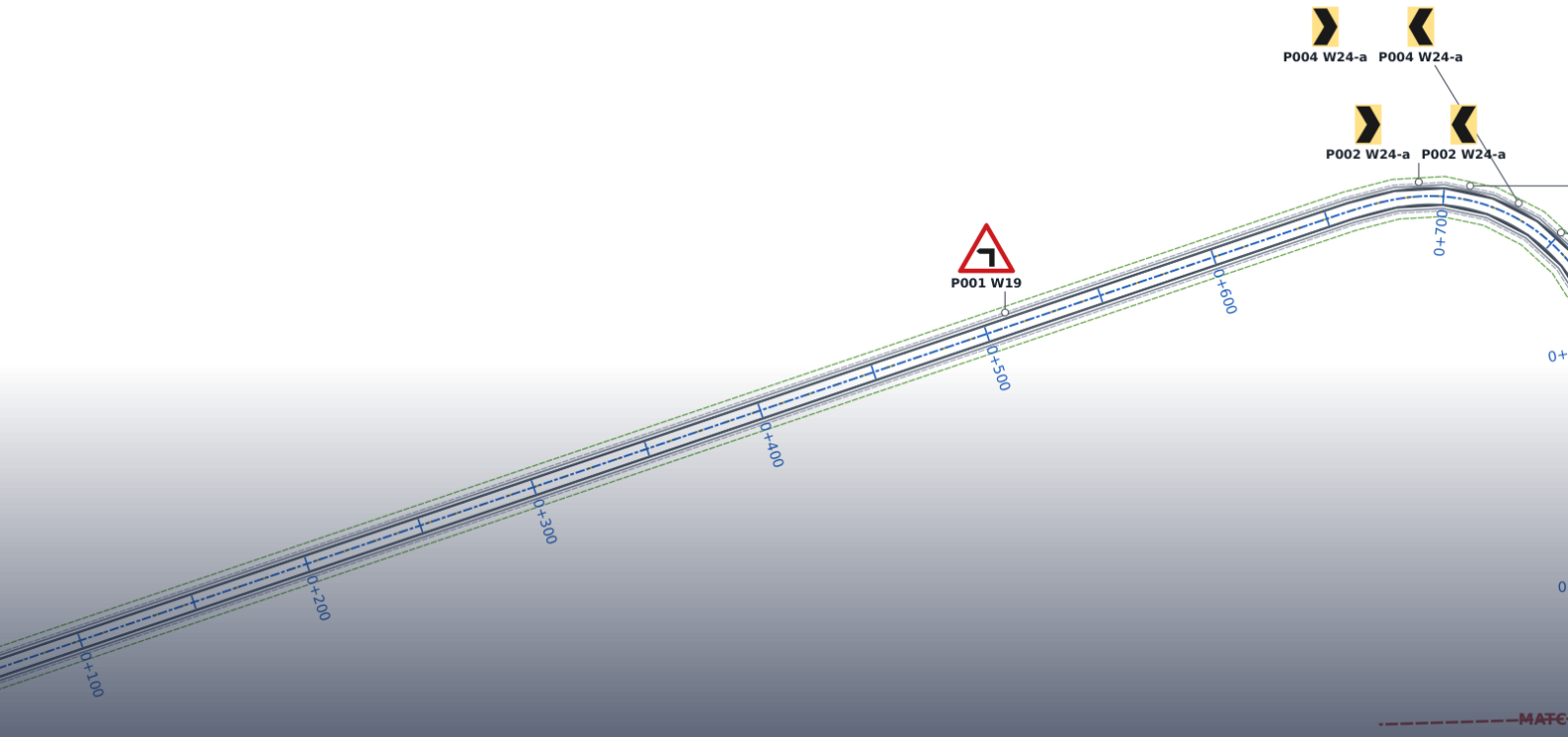


STABLE RELEASE

QGIS PLUGIN · VERSION 0.12.1

Road Furniture Designer

User Guide and Technical Manual

Author	Edmond Akello
Licence	GNU General Public License v2 or later
Status	Stable, in active development
QGIS	3.44 or later, including QGIS 4 (tests run headless on 3.44 and 4.2)
Civil 3D	2026 and later, by copy and paste from a georeferenced DXF
Standards	Kenya Road Design Manual (2025): Part 6.2 Traffic Signs, 6.1 Road Marking, 6.4 Other Traffic Control Devices, 1.3 Geometric Design
Demo data	A synthetic 4.4 km road (tools/guide/make_guide_road.py)
Edition	November 2026

Road Furniture Designer is under active development; behaviour, defaults and outputs may change between versions. Check every item against the Road Design Manual and the project's design criteria before issue.

Contents

PART 1 · GETTING STARTED

1 About this edition
2 What Road Furniture Designer does
3 Installing the plugin
4 Quick start

PART 2 · SIGNS

5 A project from a LandXML
6 Placing signs
7 Legends, plates and values
8 Moving and editing signs
9 Checks while you work
10 Auto-placement
11 Speed limit zones

PART 3 · MARKINGS, BARRIERS, TRAFFIC CALMING AND JUNCTIONS

12 Linear furniture and drawing by hand
13 Markings and road studs
14 Safety barriers
15 Traffic calming and crossings
16 Junctions, roundabouts, accesses, bays and lanes

PART 4 · OUTPUTS

17 Inventory for the QTO
18 Road furniture report
19 Furniture checks
20 DXF for Civil 3D drawings
21 Copy and paste at the true coordinates

PART 5 · TECHNICAL MANUAL

22 Data model
23 What is read from the LandXML
24 Geometry methods
25 Design criteria and formulas
26 The sign catalogue
27 Plan layout of symbols and sheets
28 Verification
29 Limitations and roadmap
30 Troubleshooting
A Appendix: fields and layers

PART 1

Getting started

What Road Furniture Designer is for, what this edition can and cannot do yet, and how to get from a Civil 3D LandXML to a signed and marked road.

1 About this edition

A FIRST DRAFT FOR AN ENGINEER

This guide describes version 0.12.1. Every figure comes from a synthetic demonstration road made by `tools/guide/make_guide_road.py` : a 4.4 km two-lane road with a sharp curve, a series of bends, short crests, a steep descent onto a high embankment and a 50 km/h village, written as a Civil 3D style LandXML. Treat the tool's proposals as a first draft for an engineer to review, not as a design.

What has been checked:

- 380 automated tests of the core library, including randomly generated roads run through signs, markings, barriers, traffic calming, speed limit zones and the report checks, the junction templates and the packaged plugin ZIP; and 66 headless QGIS tests (QGIS 3.44 and 4.2, offscreen).
- Nine alignments from private Civil 3D project exports (Arc 1960 / UTM 36S and 37S, up to 59 MB with TIN surfaces and corridor sections; project names withheld) run through the whole workflow: auto-placement, markings, barriers, features, speed zones, report, inventory and DXF.
- DXF georeferencing: every exported sign maps back to its chainage and offset with no measurable difference, and signs pasted with COPYBASE and PASTEORIG landed on the alignment in a Civil 3D project drawing (section 21).

RESULTS DEPEND ON THE CIVIL 3D MODEL

Road Furniture Designer only knows what the LandXML tells it. Its chainages, proposals, checks and report are as good as the design work in Civil 3D and the export settings, so before relying on the output make sure that:

- **Design speeds** are defined along the alignment (design criteria / speed stations). Where none are exported the tool assumes 80 km/h throughout.
- **Superelevation** is calculated and applied to the alignment. Where it is missing, curve speeds use 4 %.
- **The design profile** (finished road level) is attached to the alignment and is the final one. Without it there are no grade, crest, sag or no-overtaking checks, and no centre line can be proposed from them.
- **The corridor** is built with coded points (ETW, EPS, Hinge, Ditch, Daylight) and its cross-sections are sampled along the whole road, with the existing ground. Without them signs are offset from the centreline, edge lines need a typed carriageway width, and barriers cannot be proposed.
- **The drawing's coordinate system** is set, so the LandXML carries it to QGIS and the DXF.

The dock's summary lists what was found after opening a project, and shows in red anything missing and the default used instead.

2 What Road Furniture Designer does

Placing traffic signs, markings and barriers in Civil 3D and then counting them for the schedules is slow, manual work. Road Furniture Designer moves both jobs into QGIS, next to the road alignment:

1 · LandXML
Alignment, profile, speeds, superelevation and corridor sections from Civil 3D.

2 · Design
Signs, markings, studs, barriers, humps, crossings, speed limit zones, junction islands, bus bays and climbing lanes, placed by hand or proposed from the manuals.

3 · Inventory
Chainage, offset, side, facing and quantity, kept live as items move.

4 · Report
Plan, long-section and strip sheets, schedules and checks (PDF, PNG, Excel).

5 · Civil 3D
Georeferenced DXF, pasted into the project drawing at the true coordinates.

Signs are points and linear items are runs in one GeoPackage. Their chainage, offset, side, facing, size, grade and clearance from the road edge are worked out from the alignment and recomputed whenever they move.

Scope:

- **Automate what the alignment decides.** Curve and grade warnings, no-overtaking signs and lines, edge lines, studs and embankment barriers follow from the geometry and are proposed. Where a hump, a crossing, a speed limit, a junction or a bus bay goes is the designer's call; RFD details and signs it. Climbing lanes can be proposed from the profile. Rest areas, structures, junction geometry, stop lines and kerb lines are left to the designer.
- **A manual option for everything.** Every proposal can be edited or removed, and any sign or run can be placed by hand, which covers dual carriageways and unusual corridors.

- **Inventory, not a Bill.** Outputs are counts, lengths, areas and chainages that feed the separate QTO and Bill process. There are no rates.
- **Civil 3D 2026+ through a georeferenced DXF.** No compiled .NET add-in.

3 Installing the plugin

1. Download the plugin ZIP, `road_furniture_designer-<version>.zip`, from the **Assets** of a release on the repository's Releases page (or, for the latest main, from **Actions → plugin zip → Artifacts**, unzipping the outer layer GitHub adds). Do not use the repository's green **Code → Download ZIP**, or the **Source code** links GitHub adds under every release's Assets: they are the source, which QGIS cannot install.
2. In QGIS, open **Plugins → Manage and Install Plugins** and search for **Road Furniture Designer** in the official repository, or use **Install from ZIP** and choose the plugin ZIP.
3. Enable **Road Furniture Designer**. A dock opens, tabbed beside the Processing Toolbox at full height, with the **Section**, **Signs**, **Auto**, **Linear**, **Calming**, **Speed limits**, **Junctions + bays** and **Outputs** tabs. Each tab scrolls, so the dock fits a laptop screen beside other panels. The toolbar button shows the dock again, and brings it to the front if it is tabbed behind another panel. The **Guide** button on the dock (or **Plugins → Road Furniture Designer → User Guide and Technical Manual**) opens this guide's PDF edition, which ships inside the plugin, so it works offline.
4. Nothing else needs installing. The plugin writes its Excel workbooks and DXF drawings itself, with Python's standard library only, so it works where `pip` is blocked.

> **UPDATING**
> Install the new ZIP over the old one and restart QGIS. Existing projects open in newer versions; missing fields and layers are added automatically.

4 Quick start

1. **New project…**: choose the LandXML, the alignment and where to save the GeoPackage. The layer CRS defaults to the LandXML's.
2. **Auto tab → Propose signs**. Proposed signs appear with an orange ring. Look through them, then **Accept all proposals** or remove the ones you do not want.
3. **Linear tab → Propose markings** and **Propose barriers**; review and accept in the same way.
4. **Calming** and **Speed limits** tabs: add humps, crossings and speed limit zones where the design needs them.
5. **Junctions** tab: place the islands and markings of a junction type at each junction and fit them to the kerb lines.
6. **Signs tab**: add anything else (junction and direction signs, place names) by picking a sign and clicking on the map.
7. **Outputs tab → Road furniture report**: choose the plan scale and fill in Prepared / Checked / Approved by. Read the furniture checks.
8. **Outputs tab → Export to Civil 3D (DXF)**, then paste into the project drawing (section 21).

To try it without project data, run `python tools/guide/make_guide_road.py guide_road.xml` and open the file it writes.

PART 2

Signs

Creating a project, placing and editing signs, writing legends, the checks that run as you work, the auto-placement engine and speed limit zones.

5 A project from a LandXML

New project… asks for the LandXML, the alignment (a file can hold several), and a GeoPackage to save. The GeoPackage is the master record: it holds the signs, the linear runs and a copy of everything derived from the LandXML that the map needs.

Layer	Contents
RFD signs	One point per sign face, drawn with its RDM artwork (faces on one post are stacked).
RFD linear furniture	Markings, road studs, barriers, humps, bar sets and crossings as runs along the road.
RFD alignment, RFD chainage	The alignment, with ticks and labels every 100 m.
RFD road edges	Corridor edges from the LandXML cross-sections, coloured by code (ETW, EPS, Hinge, Ditch_In, Ditch_Out, Daylight), or the edges of the typical section (below).
RFD vertical curves	Crest and sag PVIs with length, K and A.

The layers take the LandXML's coordinate system when the file declares one. If the QGIS project uses a different CRS the plugin says so; keeping both the same avoids confusion when exchanging with Civil 3D.

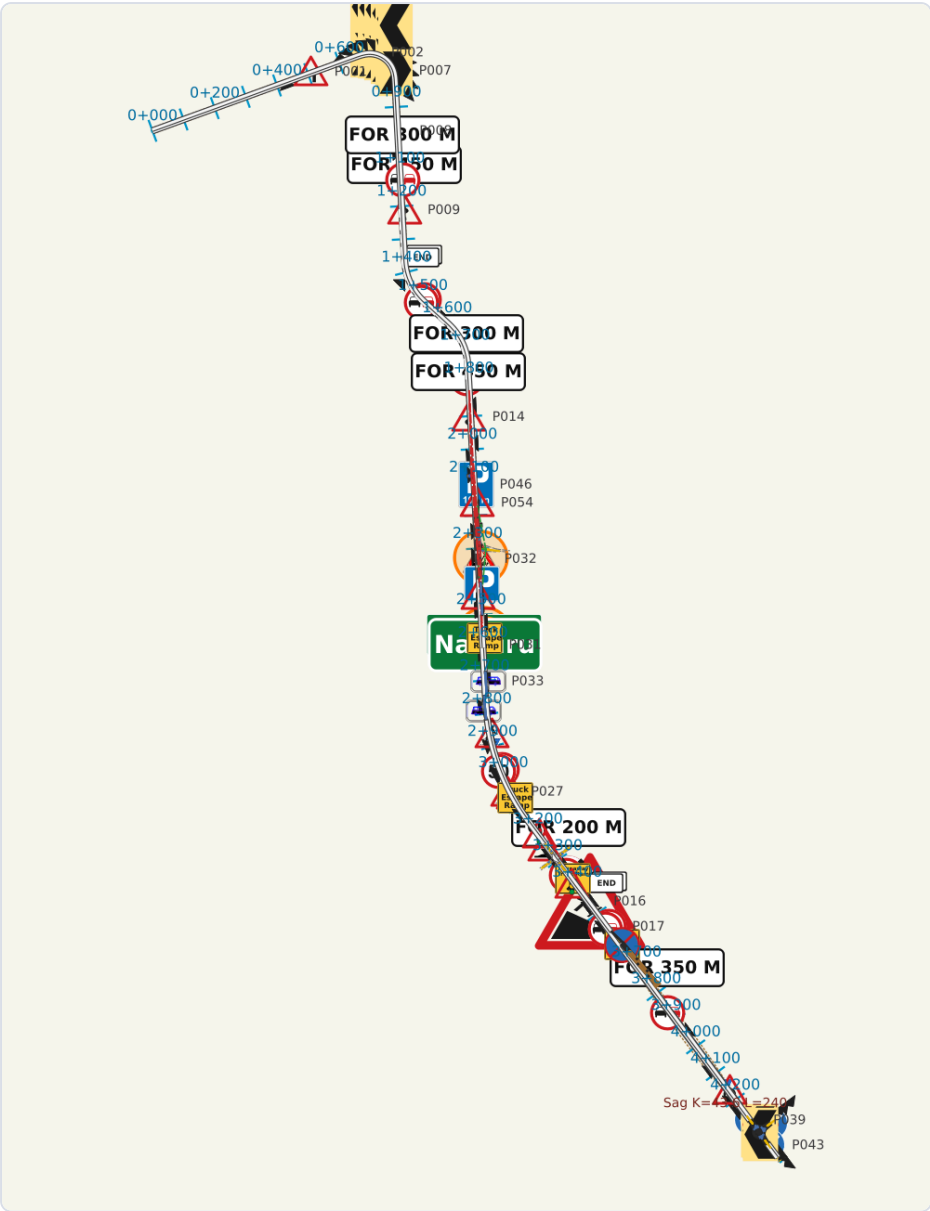


Figure 1. The demonstration road after auto-placement, markings, barriers, a crossing, a hump and the village speed limit zone.

A LandXML with only the centreline: the typical section

For rapid planning or a self-audit, a LandXML with only the alignment, its design profile and the existing ground profile is enough. On the **Section** tab give the typical section: one row per chainage range (blank From / To are the road's ends), and for each side the elements from the centreline outwards as `CODE width`, for example `ETW 3.5, EPS 2.0` or `ETW 3.5, EPS 1.5, NMT 2.0, Walkway 3.0`. **Use standard** fills one range with a single-carriageway section of RDM 1.3 Tables 4.23 and 4.24 (R4 to R9, U5, U6). Widths change linearly over the given length after the start of a range. Press **Apply section**.

The section produces the same edge table a corridor gives, so every tool uses it unchanged: sign clearances and **Keep inside the corridor**, edge lines and studs, offsets of linear runs, crossings, bays, climbing lanes and junction pieces. The `RFD road edges` layer is rebuilt from it (ETW dashed, as it is assumed) for QGIS snapping. Embankment barriers use a simplified section: the paved width at the crossfall (superelevated on curves from the LandXML's superelevation), the verge at its fall, the hinge at the outer edge and the fill batter down to the existing ground level at the centreline (cut batter where the ground is above). The project summary, the report's notes and the furniture checks say the edges are assumed.

The section is kept in the GeoPackage. Where the LandXML has a corridor, the corridor is used unless **Use it even where the LandXML has a corridor** is ticked; applying the section then lists where the corridor's ETW and EPS differ from it by more than 0.3 m, which is the check once the design comes back from Civil 3D. **Switch off** goes back to the corridor, or to no edges. Bays, climbing lanes and junction widenings are drawn on top of the section and listed in the Widenings table as before; they are not added to the section's edges. **Side roads** gives the LandXML's other alignments that have no corridor a standard section, so a junction on one of them sits at its edge (3.5 m is assumed otherwise). **Save to file…** and **Load from file…** keep a section for other projects.

Feature lines for Civil 3D (LandXML)… (Outputs tab) writes the road edges, and the widened edges of bus and truck bays, climbing lanes and junction widenings, as 3D feature lines: a LandXML 1.2 file with one `PlanFeature` per line, in site `RFD`, with the source file's units and coordinate system. In Civil 3D, **Insert → LandXML** creates them as feature lines, ready to use as corridor width and elevation targets. Levels come from the design profile plus the section: the corridor's coded points where the LandXML has a corridor (superelevation included), or the typical section's: the crossfall, superelevated on curves as the LandXML's superelevation gives it (rotation about the centreline; the outer side through level to the full rate over the runout and runoff), and the verge fall. Where the LandXML has no superelevation the levels stay at the normal crossfall, which the file says. Beyond the pavement edge, a widening carries the last crossfall on. They are written as Civil 3D writes its own feature lines: PIs only where the plan needs them (a true arc wherever an edge runs parallel to an alignment arc, in Civil 3D's three-point form, and straight segments thinned to 20 mm elsewhere), and the levels between them as elevation points, thinned to 5 mm against the grade; Civil 3D handles elevation points far more lightly than PIs. A line longer than 5 km is written in pieces (`RFD ETW L-1`, `RFD ETW L-2` …). On a 36 km road that is about 530 PIs per edge, against 7,245 in the first version of the export. Exported from a Civil 3D corridor, the edges agree with the corridor feature lines Civil 3D itself exports to within about 1 cm in plan and level. They are a first set of targets to refine, not a finished design.

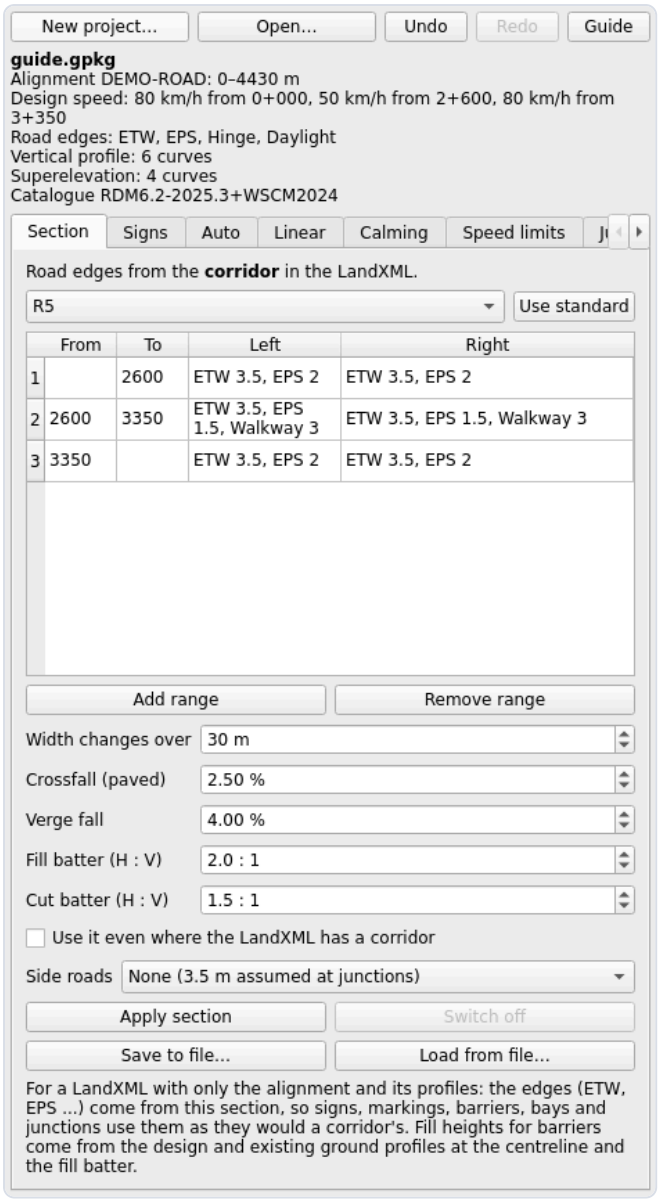


Figure 2. The Section tab with an R5 rural section, a village section with walkways from CH 2+600 to 3+350, and a rural section with 2 m shoulders beyond it.

6 Placing signs

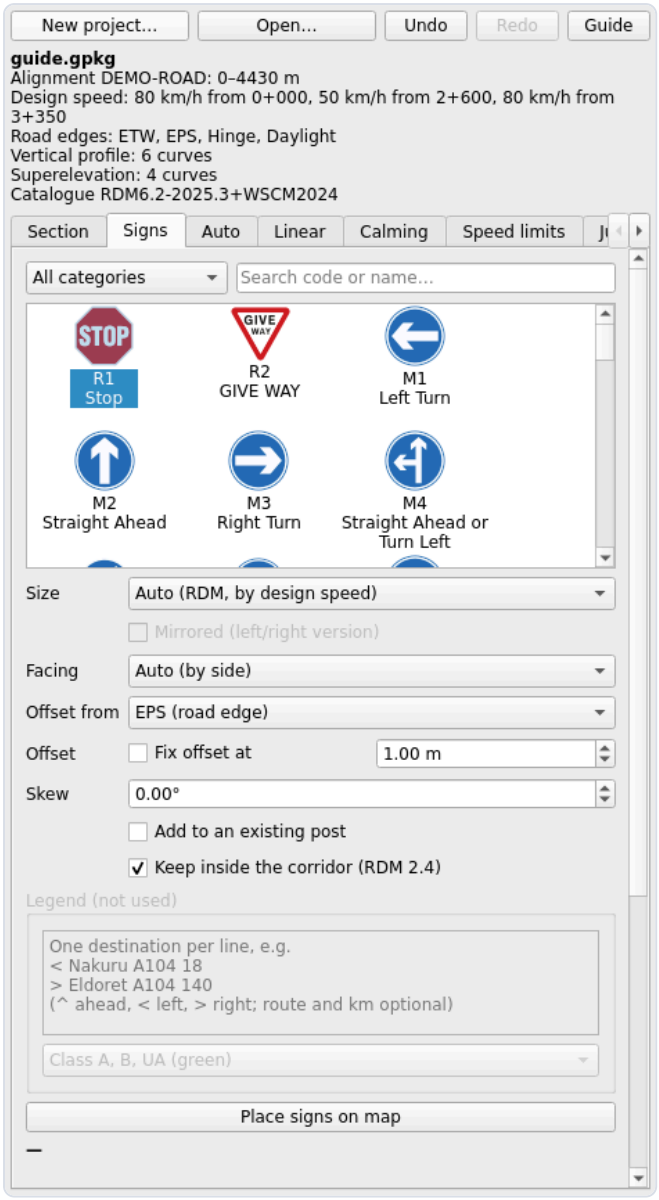


Figure 3. The Signs tab: catalogue palette, size, facing, offset rule and legend for placing, then every face placed, in chainage order with its clearance from the road edge.

1. **Pick a sign** from the palette. Filter by category or search by code or name.
2. **Size.** *Auto (RDM, by design speed)* applies the manual's size tables using the design speed at the sign's chainage. Choose a size to override it.
3. **Mirrored** gives the left/right version of signs the manual shows one way round (bends, side roads, chevrons).
4. **Facing.** *Auto* follows driving on the left: a sign on the left faces up-chainage traffic, a sign on the right faces down-chainage traffic. Choose Forward or Backward to override, for example in a median.
5. **Offset from** a road edge (EPS by default) and **Fix offset at** place the post at a set distance beyond that edge at the chainage you click.
6. **Keep inside the corridor** (on by default) snaps the post into RDM 6.2 §2.4's band, 0.6 to 3.0 m beyond the edge, and never beyond the ditch or daylight line where those are modelled.

7. **Add to an existing post**: click an existing sign to put another face (a plate, a back-to-back sign) on the same post.
8. **Place signs on map**. Hovering shows chainage and offset; left-click places, right-click stops.

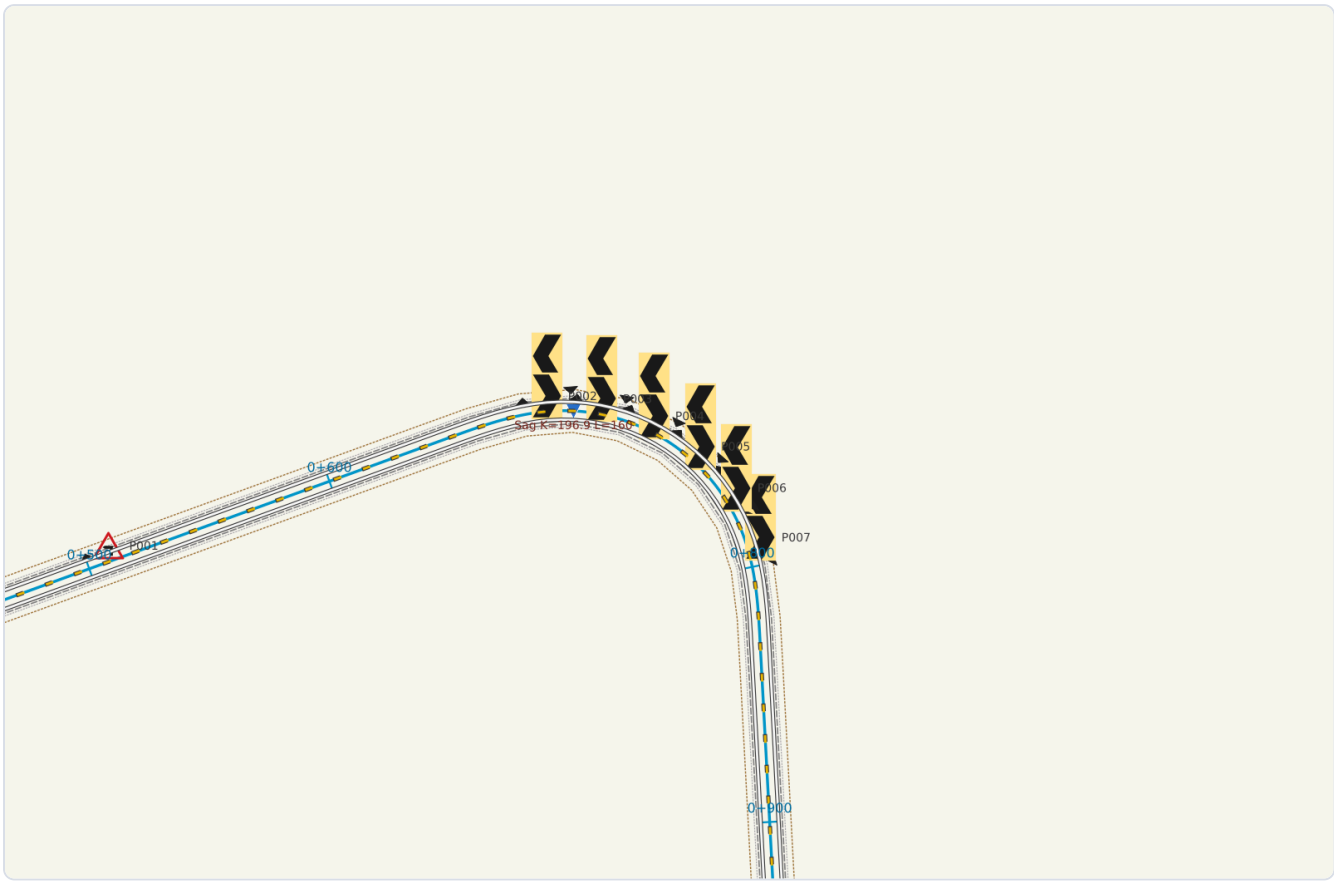


Figure 4. The sharp R 75 m curve near CH 0+740: corridor edges, chainages, the combined centre line and edge lines, the curve warnings and the chevrons placed by the engine.

7 Legends, plates and values

Directional signs, town and county signs and text plates carry text that changes from job to job. Type the legend before placing, or select the sign on the Signs tab and use **Edit legend…**. One destination per line:

```
^ Nakuru 6              ahead, 6 km
< Molo B4 32            left, route B4, 32 km
> Eldoret A104 120      right
```

- Arrows: `^` or `A` ahead, `<` or `L` left, `>` or `R` right. A line with no arrow is plain text (plates).
- Destinations are ordered as RDM §5.2 asks: ahead, then left, then right, furthest first.
- Faces are drawn in the RDM Table 2.6 colours for the road class: green with yellow route numbers (A, B, UA), white (C, D, UC and lower), blue (expressway).
- Signs whose artwork carries a value take it from the legend. A W30 steep-descent sign proposed for a 6.8 % grade reads 7 %, not the manual's 10 % sample, on the map, in the report and in the DXF.

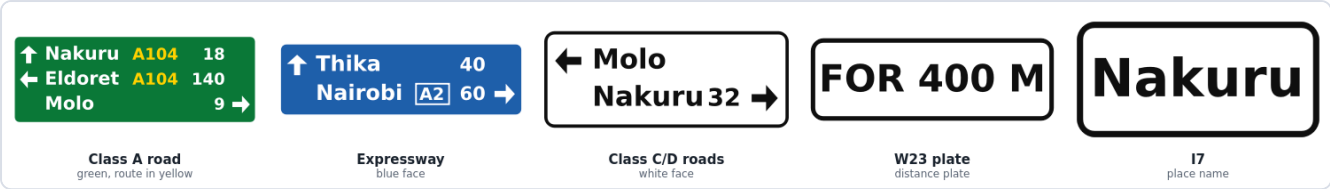


Figure 5. Legend faces drawn by the plugin: directional signs in three colour schemes, a distance plate and a place-name sign.

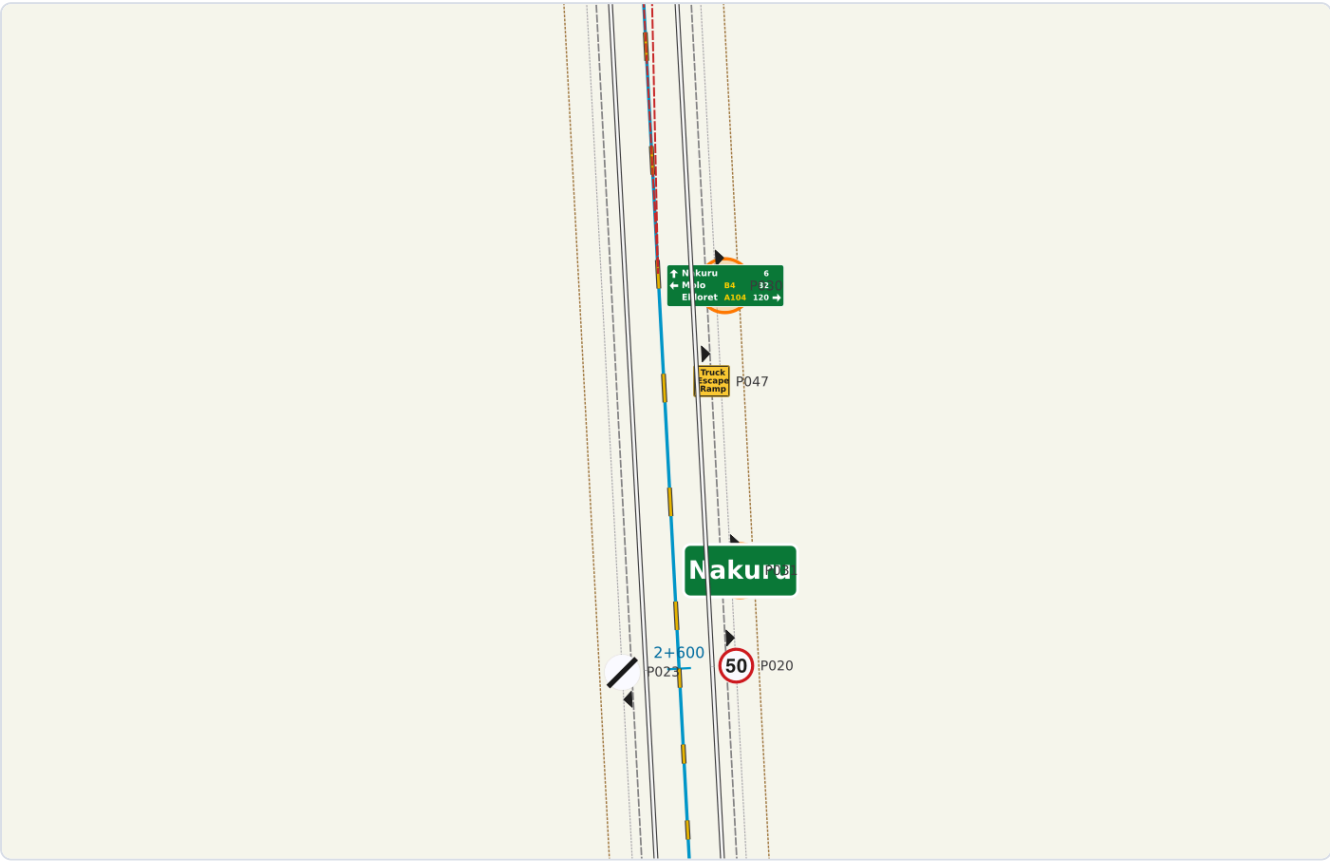


Figure 6. A directional sign and a place-name sign added by hand at the village entry, CH 2+560.

8 Moving and editing signs

- Move signs with the normal QGIS editing tools (Toggle Editing → Move Feature). Chainage, offset, side, auto-facing, size, grade and edge clearance update at once, and every face on the same post moves with it.
- Editing `facing` in the attribute table switches Auto facing off for that sign; typing a size switches Auto size off.
- The **Signs** tab lists every face in chainage order. Double-click a row to zoom to it. **Renumber posts by chainage** renames posts P001, P002… in road order.

9 Checks while you work

The Outputs tab lists checks for the whole sign list. Errors block the Civil 3D export; warnings do not. The report adds the furniture checks of section 19.

Check	Level	Rule
Inside the travelled way	Error	Post closer to the centreline than the edge of travelled way (ETW).
On the shoulder	Warning	Post between ETW and the edge of paved shoulder (EPS).
Outside the RDM lateral band	Warning	RDM 6.2 §2.4: 0.6 to 3.0 m beyond the carriageway or paved-shoulder edge.
Outside the corridor	Warning	Beyond the ditch or daylight line, where the verge is modelled.
Spacing	Warning	RDM 6.2 §2.4: consecutive signs at least 0.6 V metres apart (48 m at 80 km/h).
Legend missing	Warning	Directional signs and plates need their text.
Post consistency	Error	Faces on one post at different positions, or with different post or foundation types.
Unknown code, size, post or foundation	Error	Not in the catalogue.

10 Auto-placement

The engine reads the alignment's geometry and proposes the warning and regulatory signs RDM 6.2 calls for. Proposals are suggestions: an engineer accepts or removes each one.

Situation	Signs proposed	Basis
Curve whose safe speed is 10 km/h or more below the approach speed	W20 bend (W19 sharp turn when 30 km/h or more below), both directions, at the advance distance	RDM 6.2 §4.5; $V^2 = 127\ R\ (e + f)$
Warned curves closer than 150 m	W22 series of bends (W21 sharp) with a W23 distance plate	RDM 6.2 §4.5
Curve 20 km/h or more below the approach speed	W24-a chevrons on the outside of the curve, back to back, at Table 4.2 spacing	RDM 6.2 §4.6.1, Table 4.2
Descent steeper than 5 %; ascent steeper than 10 %	W30 / W31 with the actual grade	RDM 6.2 §4.6.4
Sight distance below the passing sight distance	P32 with a W23 distance plate at the start; P32 with the supplementary END plate at the end; in each direction	RDM 6.2 §3.11; RDM 1.3 Table 3.20
Sag with headlight sight distance short of SSD; crest short of SSD	Reported as findings (no sign proposed)	RDM 1.3 Tables 6.1, 6.4

Signs go at the advance distance (6 seconds of travel at the design speed, RDM 6.2 §2.4), on the left for up-chainage traffic and on the right for down-chainage traffic, at the set clearance beyond the reference edge, and are moved back where they would be closer than 0.6 V metres. Running it again never duplicates a sign, a chevron or a plate already there.

On the demonstration road (80 km/h, 50 km/h through the village) the engine reports 10 findings and proposes 35 faces in under half a second: the R 75 m curve (safe speed 47 km/h, a W19 sharp turn with chevrons), two R 180 m bends 70 m apart (a W22 series with its plate), a 6.8 % descent, and two no-overtaking zones in each direction over the short crests.

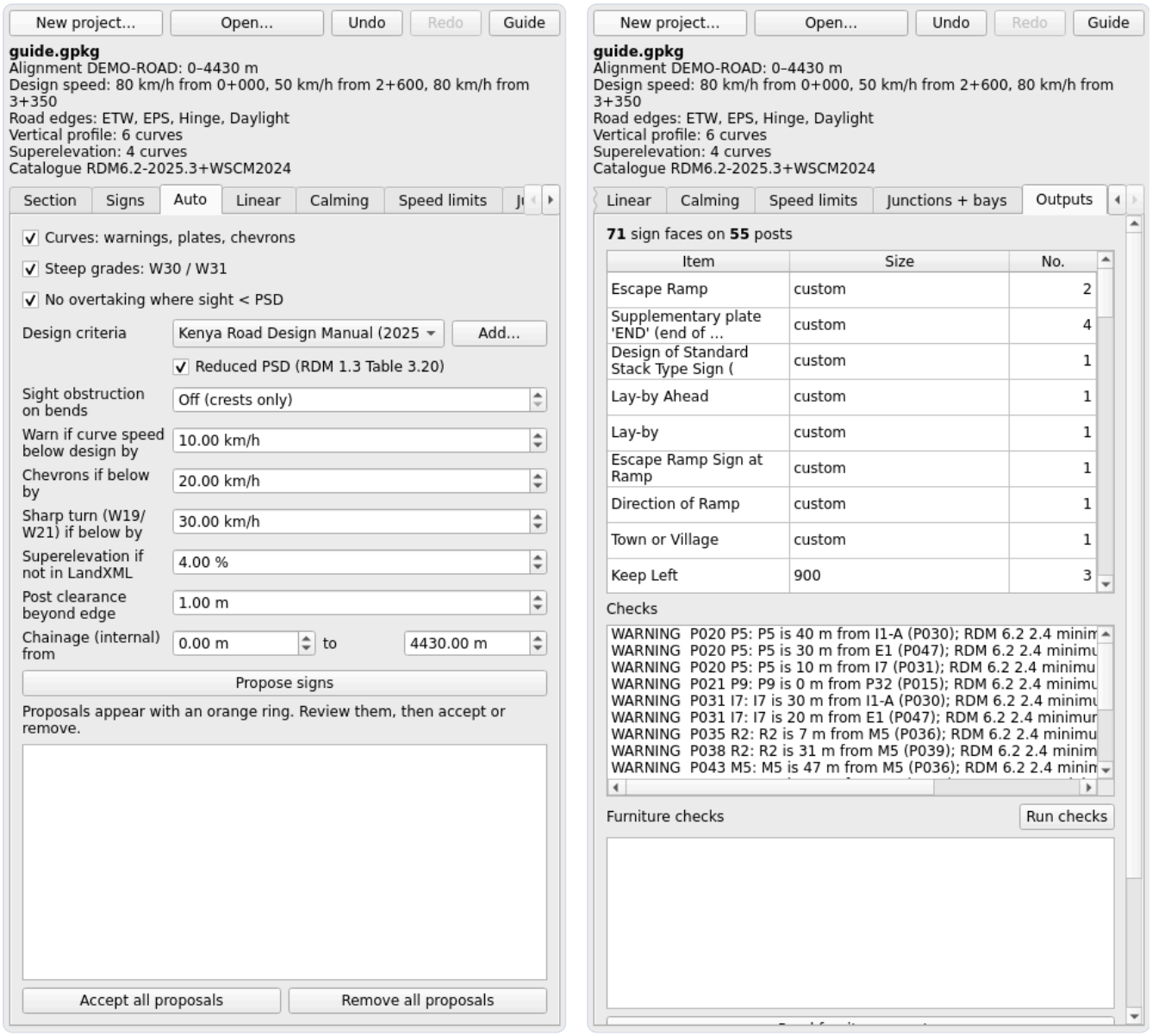


Figure 7. The Auto tab (left): rules, thresholds and chainage range. The Outputs tab (right): the inventory (live counts and checks) and every export.

1. On the **Auto** tab, tick the rules to run and set the chainage range (the whole alignment by default).
2. **Propose signs**. Proposals are added with status `proposed`, drawn with an orange ring, and listed with the reason for each (for example *R=75 m, e=6.0 %: curve speed 47 km/h vs 80 km/h design*).
3. Review on the map and in the report, which shows proposals too. Move, edit or delete individual proposals as needed.
4. **Accept all proposals** turns every remaining proposal into ordinary furniture: signs, and the markings, studs and barriers proposed on the Linear tab. **Remove all proposals** deletes all that are still proposed. The Linear tab's own buttons act on the linear proposals only. Signs belonging to traffic calming features and speed limit zones are left alone.

Parameter	Default	Meaning
Warn if curve speed below design by	10 km/h	Margin that triggers a bend warning.

Parameter	Default	Meaning
Chevrons if below by	20 km/h	Margin that adds chevrons.
Sharp turn if below by	30 km/h	W19/W21 instead of W20/W22.
Series gap	150 m	Warned curves closer than this are signed as a series.
Superelevation if not in LandXML	4 %	Used when the file has no superelevation for a curve.
Steep descent / ascent	5 % / 10 %	RDM 6.2 §4.6.4 thresholds; grades shorter than 50 m are ignored.
Criteria	Kenya RDM 2025	Side friction, sight distances and K values; AASHTO 2011 and user criteria files can be chosen (section 25).
Post clearance beyond edge	1.0 m	Within RDM's 0.6–3.0 m band.
Offset without corridor edges	5.5 m	From the centreline when the LandXML has no cross-sections.

11 Speed limit zones

The posted limit is the designer's decision; RFD signs it to RDM 6.2 §3.5. On the **Speed limits** tab, pick the limit (P5 50, P6 70, P7 80 or P8 120 km/h; 100 km/h is the general limit and has no sign), type the zone's chainages and press **Add zone**. For each direction RFD proposes:

- the limit sign where traffic enters the zone;
- a repeater at the middle, or at the interval set;
- **P9** (end of speed limit) where traffic leaves it. Where the zone adjoins another, that zone's limit sign marks the change instead.

It flags a limit above the design speed, a very short zone, and a zone running off the end of the alignment. **Propose from design speed** adds 50 km/h built-up area zones where the LandXML design speed is 50 km/h; a rural 70 or 80 km/h design speed does not by itself call for a special limit. On the demonstration road it proposes the 750 m village zone with six signs.

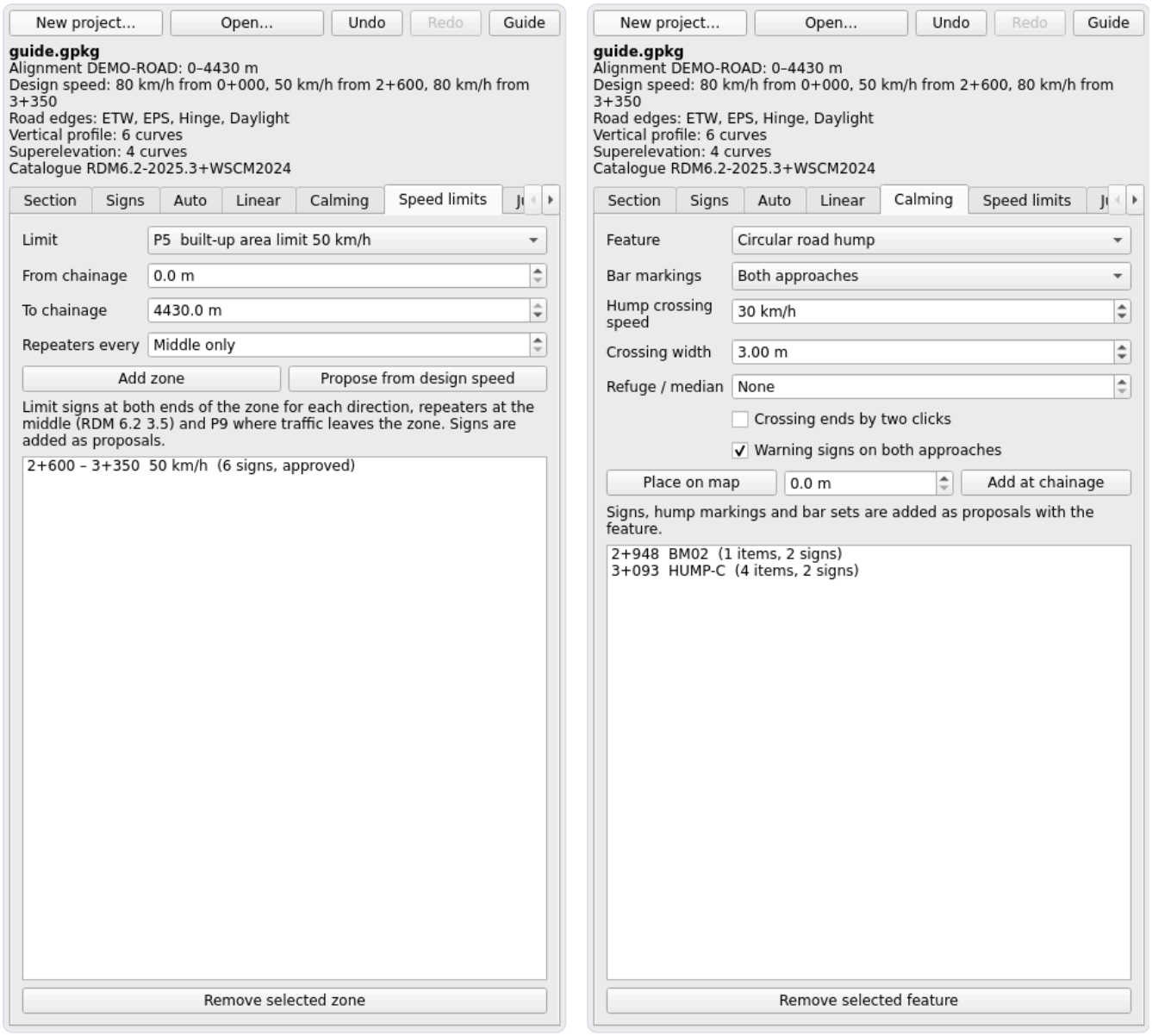


Figure 8. The Speed limits tab (left) and the Calming tab (right).

PART 3

Markings, barriers, traffic calming and junctions

Linear furniture as runs along the road: proposed from RDM 6.1 and RDM 1.3, or drawn by hand.

12 Linear furniture and drawing by hand

Markings, road studs, barriers and transverse items are stored as **runs** in the `rsd_lines` layer. A run has an item code, a start and end chainage, a side, and an offset measured either from a corridor edge (for example ETW) or from the centreline; a run tied to an edge follows it where the road widens. Geometry, length and quantity are rebuilt whenever one of those fields changes, so runs can be edited in the attribute table.



Figure 9. The Linear tab: item, side and offset, drawing on the map or by chainage, the proposal buttons and the list of runs.

On the Linear tab, pick the item and press **Draw on map**: click the start, then the end. The side and offset come from the first click; tick **Fixed offset** to use a typed offset instead (for example 7.3 m right for the median edge of a dual carriageway), or force Centre, Left or Right. **Add run at chainages** does the same from typed chainages. This covers dual carriageways, slip roads and anything the rules do not propose.

The catalogue (`rfd/data/furniture_linear.json`) is open: add or replace items with a JSON file in a folder listed in `RFD_FURNITURE_PATH` .

13 Markings and road studs

Propose markings adds the centre line, edge lines and studs (RDM 6.1) for review, like signs.

- **Centre line.** Broken (LM01, or LM02 on class A and B roads) where overtaking is allowed. A direction that may not overtake gets a continuous line: the combined line LM28 for one direction, double continuous LM32 for both.

- **One basis for signs and markings.** The continuous line covers exactly the no-overtaking zones used for the P32 signs: where the passing sight distance (RDM 1.3 Table 3.20) is not available along the profile and, if set, round bends. Zones of opposite directions closer than 100 m are extended to meet, so no short overtaking length is left between them.
- **Narrow roads.** Under 5.5 m of carriageway there is no broken centre line and no double line; a single continuous line LM24 marks no-overtaking lengths (RDM 6.1 §4.2.1, §4.5.5).
- **Edge lines.** Continuous LM26 (LM27 on class A and B) on the ETW edge, both sides; without a corridor, at half a typed carriageway width.
- **Studs.** 6 m on the combined line system, 9 m on edge lines through no-overtaking sections and 12 m elsewhere (RDM 6.1 Table 13.2); everywhere on class A, only on no-overtaking sections otherwise.

Quantities: markings in metres of run and m² painted (from the mark, gap and width of RDM 6.1 Tables 4.1–4.3), studs by number. On the demonstration road the proposal is 26 runs.

14 Safety barriers

Propose barriers works from the corridor sections (RDM 1.3 Chapter 12):

- **Fill height and batter** per section and side: from the hinge (coded point, or where the design line first drops more steeply than 1:10) to the toe where the design line meets original ground. A toe drain, bench or wall does not distort the height.
- **Original ground**, in order: the section's own ground line, a TIN surface in the LandXML sampled under the section (picked by name or chosen on the tab), else the daylight point. The barrier's reason says which was used.
- **Warrant** from the Figure 12.4 curves: required → barrier; between the curves → listed for judgement (or proposed, if ticked).
- **Length**: the warranted length plus the Table 12.6 run-out at both ends, at the highest design speed along the hazard and its approaches; an end on a bend is carried to the tangent point; at least 30 m; gaps under 80 m closed. Two terminals per run.
- **Set-back** 0.5 m from the ETW edge line, 0.75 m with AADT ≥ 12,000 and speed over 80 km/h. A verge too narrow for the set-back and post is flagged; unshielded batters steeper than 1:3 inside the clear zone are listed.

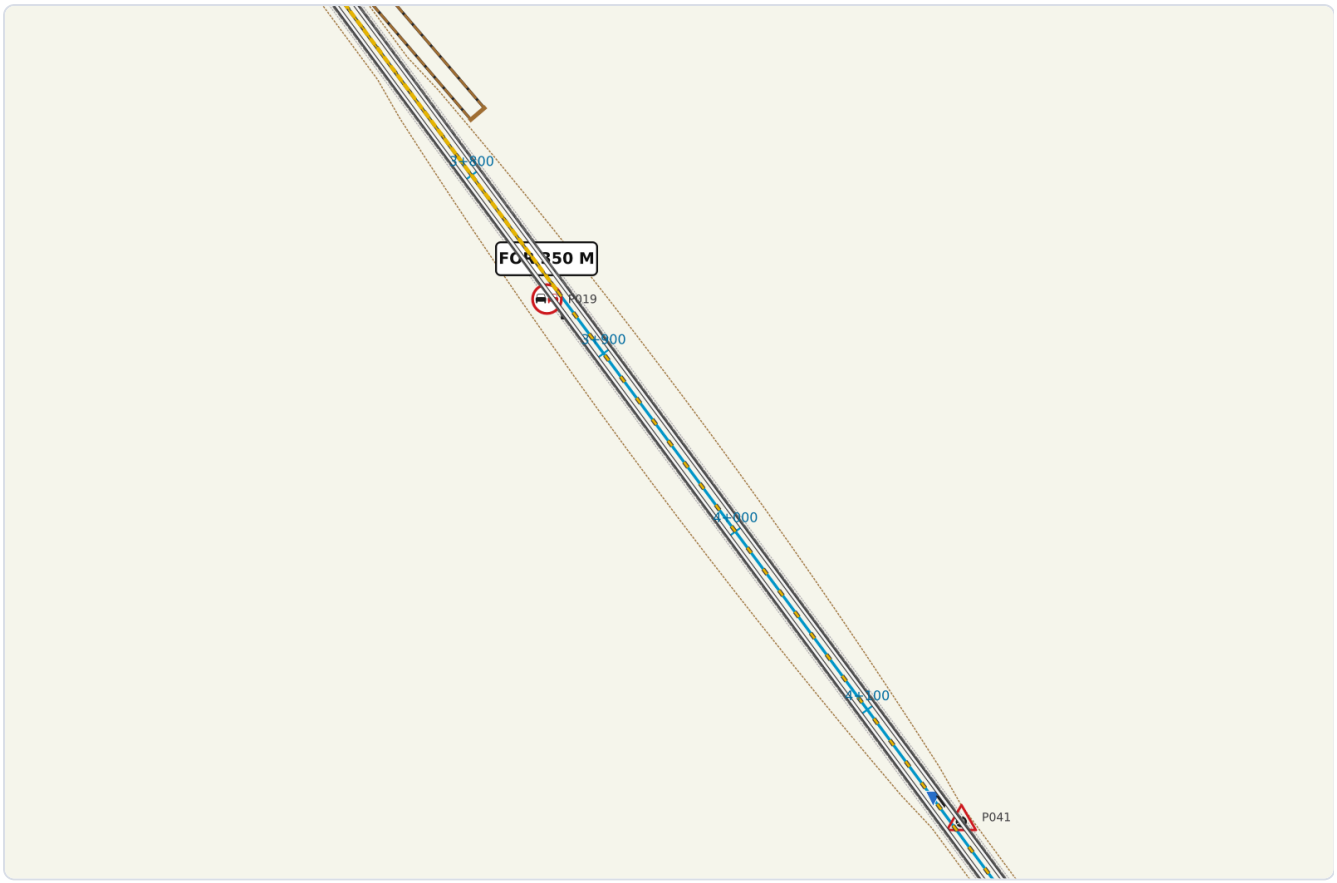


Figure 10. The 7.5 m embankment at the foot of the descent (CH 3+750 to 4+150): guardrail on both sides from CH 3+675 to 4+225, with 85 m of run-out at each end.

15 Traffic calming and crossings

Where a hump or a crossing goes is the designer's decision; RFD details it to the manuals. On the **Calming** tab pick a feature, then click **Place on map** and click the chainage, or type it and press **Add at chainage**. Each feature creates, as proposals:

- **Circular hump**: radius and chord for the chosen crossing speed (RDM 6.4 Table 2.1, 100 mm rise). **Trapezoidal hump**: ramps and gradient (Table 2.2), 2.5 m minimum flat top. **Speed table** (Figure 2.4), optionally a raised crossing, which has its own item (`TABLE-X`) so it is counted apart from speed tables. **Speed bump**: refused at a design speed of 50 km/h or more (§2.4.2).
- **Hump markings** (BM04) and **transverse bar markings** on the approaches at the Table 2.3 distances; bar markings can also be placed on their own ahead of any hazard.
- **Zebra crossing**: BM01, BM02 or BM03 for a 2, 3 or 4 m crossing (RDM 6.1 §9.2), drawn as painted bars. A leg longer than 10.5 m is flagged for a refuge island at least 1.2 m wide.
- **Warning signs** on both approaches at the advance distance: W64 for humps and bumps, W55 for crossings.
- **Checks**: the feature is visible from the stopping sight distance on the design profile; the bump speed limit, the crossing width, and items beyond the alignment are flagged.

Everything a feature creates is listed and removed together. RDM 6.2 has no pedestrian-crossing information sign; crossings are signed with W55 and the zebra.

Crossing extent and refuges. A crossing runs across the carriageway between the two ETW edges of the corridor. Where that is not what you want (part of the road, one carriageway of a dual carriageway, a road

exported without corridor edges) tick **Crossing ends by two clicks** and click one kerb, then the other: the crossing runs exactly between them. A **Refuge / median** width splits the crossing into two zebras with a kerbed refuge island between them (item `REFUGE`, counted by number); the refuge sits on the centreline when the crossing spans it, otherwise in the middle of the crossing. Each leg is checked against the 10.5 m limit, a refuge narrower than 1.2 m is flagged, and so is a refuge on a crossing of 10.5 m or less, which needs none: on a single two-lane carriageway it only narrows the lanes. Refuges are for wide crossings and medians, such as a dual carriageway crossed kerb to kerb in two legs.

Humps, bar sets and crossings are drawn as they are painted on the map, the plan sheets and the DXF: zebra bars, BM04 triangles on the hump ramps, bar sets across the lane and the hump footprint filled. Transverse items such as a single bar set or a zebra can also go in with one click from the Linear tab.

Bar markings, under the feature type, puts the Table 2.3 bar sets before humps, speed tables and raised crossings on both approaches, the forward or the backward one only, or none; the placement message says how many went in. A bar set that would fall on a junction kit, a roundabout, an access, a crossing or another hump is left out, with a note, and placing a junction over proposed bar sets removes them. A hump, table, bump or zebra that overlaps another one, or a junction or roundabout, is flagged when you place it and in the furniture checks.

Each map tool belongs to its tab: leaving the Linear, Calming or Junctions tab switches its tool off, and the hover read-out starts with what a click places (for example `Linear - BM03:` or `Calming - Circular road hump:`).

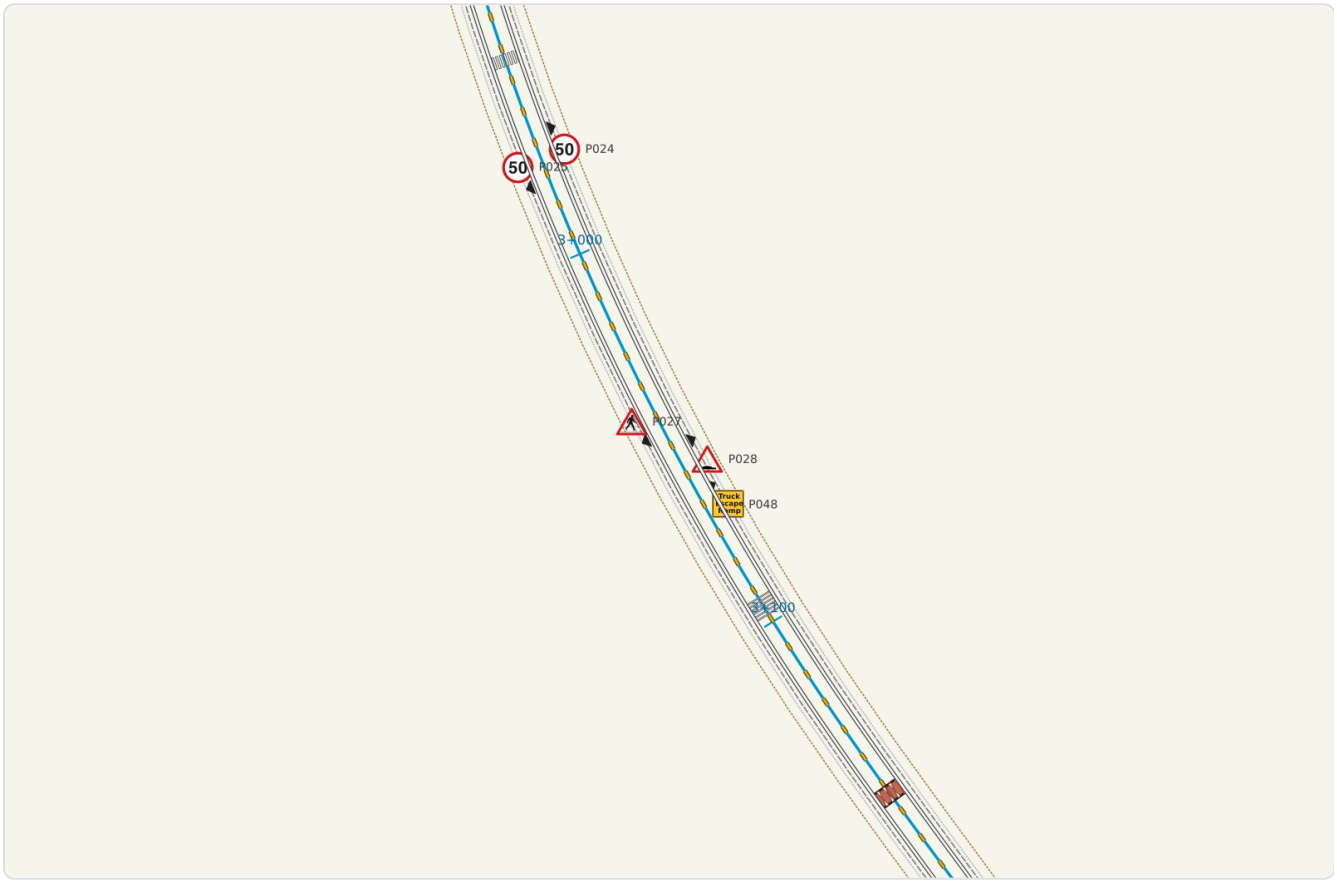


Figure 11. In the village: a 3 m zebra crossing at CH 2+950 and a circular hump at CH 3+150 (R 20 m, chord 4.0 m for 30 km/h), with their W55 and W64 signs, hump markings, bar sets and the 50 km/h limit signs.

16 Junctions, roundabouts, accesses, bays and lanes

RFD does not design junctions: the layout, kerb lines, control radii and entry widths come from the junction design. What it gives you are the islands and markings of the standard geometry drawings RDM/1/3/2/01 (type A) and RDM/1/3/2/02 (types B and C) as **templates** to place and fit, either as a whole kit for a junction type or one piece at a time.

Type	Kit
A-1	Ghost island tail on the main road (yellow hatching HM07 in an HM14 border); raised splitter island 7.5 × 3.0 m (R 1.5) with a hatched tail; raised corner island on the left-turn corner with a white hatched lead-in.
A-2	Raised teardrop splitter, about 25 m, hatched at the tail; corner islands on both corners.
B	Teardrop splitter (R 0.75); corner island on the left-turn corner.
B-Mod	Hatched strip ahead of the right-turn lane, hatched wedge beyond the junction, teardrop splitter.
C	Teardrop splitter, 10 + 10 m.

Every kit also carries the GIVE WAY line across the minor road's approach lane (TM07), the triangular GIVE WAY marking 2.5 m behind it (BM07) and 30 m of continuous centre line on the minor road (LM24), to RDM 6.1 §5.3. The sheet titled "types B, C & D" labels no panel D (its two right-hand panels both read "Type B – Modified"), so there is no type D template.

Islands come with their widenings, as on the standard drawings, so they never take width from the existing lanes. The ghost-island kits (A-1, B-Mod) widen the main road on both sides by half the island's width over the island and its tapers (drawn as `WIDEN`), and their other pieces stand off the widened edge. Behind a corner island (A-1, A-2, B) RFD draws a bellmouth with the turning roadway (4.9 m; 5.5 m in A-2, as RDM/1/3/2/01 W2) and the kerb return from it, and the minor road flares around its splitter island. Widenings on our road go to the Widenings sheet for Civil 3D and into the round-trip check, like the bays.

1. On the **Junctions** tab pick the junction type, then **Whole type ... kit** or a single piece, and the scale.
2. Press **Place on map** and click the junction point on the main road; it snaps to the centreline.
3. Move up the minor road. The pieces follow, with the crossing angle shown; click to place them. When the minor road is another alignment of the LandXML and the mouse is within 15 m of it, the direction follows that alignment, so you don't have to aim along it.

The second click sets the minor road's direction, so the pieces take the skew: corner islands shear with it, and pieces on the main road follow its curvature. Kenya drives on the left, so the approach lane, the left-turn corner and the ghost island tail land on the right sides whichever side of the main road the minor road leaves from. **Scale** enlarges or shrinks the pieces about the junction point, before placing or, with **Apply scale to selected**, afterwards. The shapes follow the dimensions written on the sheets; the sheets are not drawn to scale, so treat the pieces as a starting point and fit them to your kerb lines.

Guide lines (on by default) are construction lines for sketching and fitting: the main-road edge, the minor road's centreline and edges, the kerb returns (three-centred curves R1 : R2 : R3 = 2 : 1 : 3 as in RDM 1.3 Figure 9.25, R2 half the kit's return radius within 8-12 m) and the Rc turning arcs, tangent to the main-road centreline through the splitter nose (Rc 15 m, as recommended on RDM/1/3/2/01). They carry no quantities and sit on their own layer category and DXF layer, so you can switch them off.

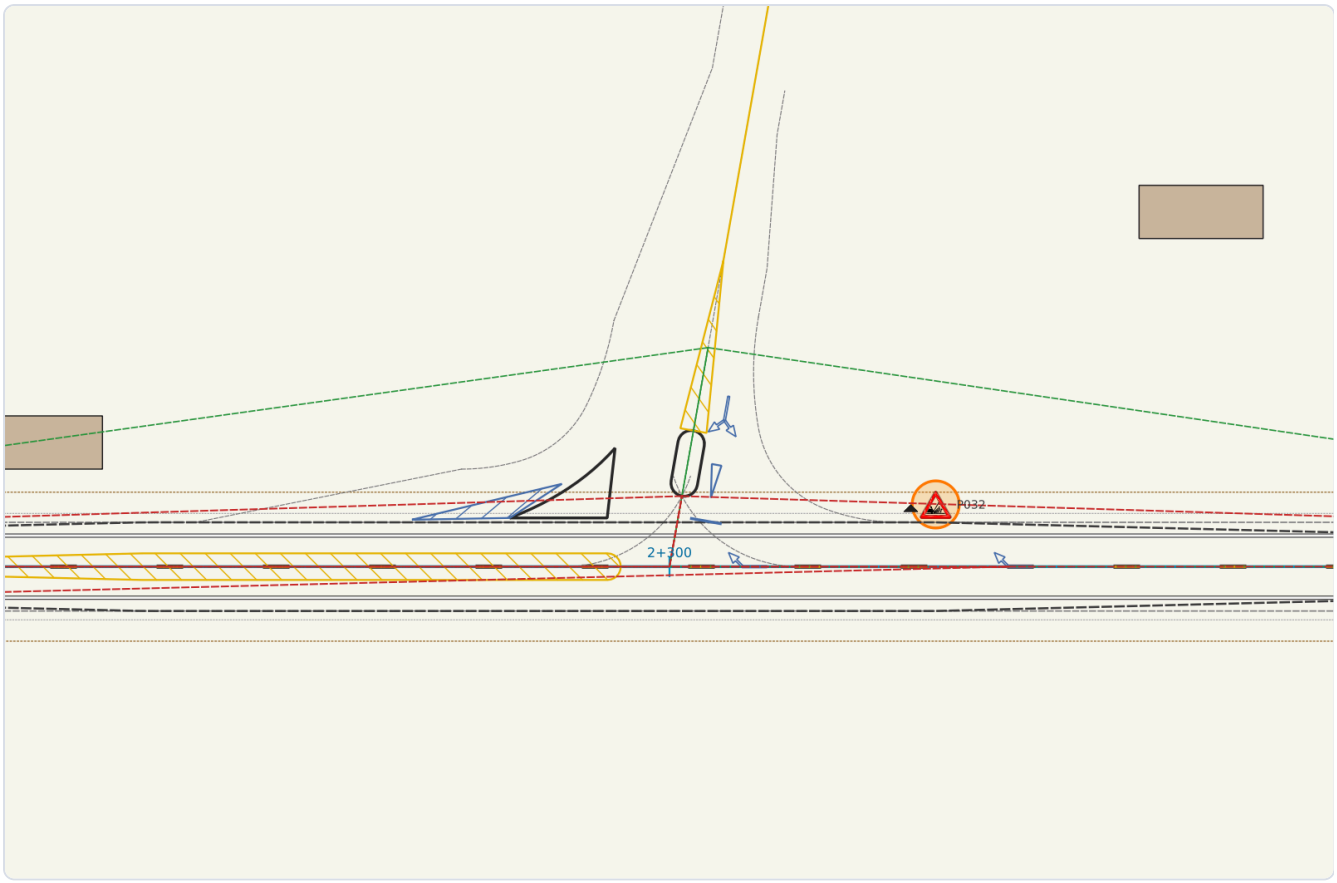


Figure 12. A type A-1 kit at CH 2+300 on the demonstration road, the minor road leaving at 80°: ghost island tail, splitter and corner islands, GIVE WAY markings, the LM24 line, AM06 and AM03 arrows, the main road widened on both sides around the ghost island, the bellmouth behind the corner island, and the guide lines (dashed) for the kerb returns and the Rc arcs.

The pieces are kept in the layer `rsd_junctions`, one feature per piece and marking code, with the rule `junction:<id>`. Editing `sta`, `bearing_deg`, `scale` or `edge_m` in the attribute table rebuilds the piece from its template. The list on the tab shows each junction's chainage, type, side, crossing angle and quantities; double-click to zoom, or remove a junction with all its pieces. The templates are open data in `rfd/data/junction_templates.json`.

Where our road joins another road

Often the road being designed is the minor road: it ends at, or crosses, an existing or another design road. Set **Junction** to **Our road joins another road** and choose the **Main road**: another alignment in the same LandXML, or **Click its direction** where the main road is not in the export.

1. Click our road where it meets the main road; the point snaps to our centreline.
2. With an alignment as the main road, move the mouse to the side of the main road where our road's approach is: the preview shows the kit on that leg, and the hover text names it by chainage. Click to place. Where our road crosses the main road, moving the mouse across flips the kit to the other leg; tick **Both legs (our road crosses it)** to place a crossroads in one go, with the islands, GIVE WAY markings and an R2 on each approach and the main-road pieces drawn once. With **Click its direction**, click a point along the main road at least 1 m away; the main road is taken as a straight line through the junction in that direction.

The pieces are built in the main road's frame, as above, so the main-road pieces follow the other alignment and the minor-road pieces sit on our approach: the GIVE WAY line, the triangle and the LM24 line. An **R2 Give Way** sign is proposed on the left of our approaching traffic, just behind the give way line. It carries the

junction's rule, so it stays when auto-placement is re-run and goes when the junction is removed. The list shows these junctions as "joins <alignment>" or "joins main road".

Signs and arrows with a junction

Placing a kit also proposes the **Junction Ahead** warnings on our road (RDM 6.2 §4.2), at the advance distance for the design speed: W2 Side Road (mirrored to the side the side road leaves from) for each approach where our road is the main road, W1 Crossroads where side roads leave on both sides within 10 m, W5 Staggered Crossroads where they leave on opposite sides within 60 m, and W12 T Junction or W11 Crossroads on our approach where our road meets a road of greater importance. They are re-proposed together whenever a junction is placed, moved or removed; one you have accepted stays as it is.

The kits carry **arrow markings** (RDM 6.1 §6.4.3): AM06 (right and left; AM07 at a crossroads) on the minor road's approach lane, and in the A-1 and B-Mod kits two AM03 right-turn arrows in the right-turn lane, 3.5, 5 or 9 m long by speed (Table 6.1). The turn lane itself comes from the junction design, so move the arrows to it if they don't fall there: **Move a piece** on the tab picks a placed piece and puts it elsewhere along the road (hold Shift for the whole junction); it is rebuilt from its template there.

Signalised crossroads

The type **Signalised crossroads** (SIG) is not one of the RDM 1.3 templates: it is the plain four-arm crossroads of single carriageways without islands that signals usually control, with its markings from RDM 6.1 §7.8 and Figure 7.12. Place it like a kit, with the junction point and a point up the cross road. RFD draws kerb returns (R 12 m) on all four corners; on every arm a BM02 crossing where the kerb runs straight, the TM01 stop line 1.5 m behind it across the approach half, 30 m of LM24 and an AM07 arrow on the approach; and proposes the W46 Traffic Signals Ahead sign on our approaches. Skewed crossings keep the edges and returns on each corner. The signals, lanes and phasing come from the signals design.

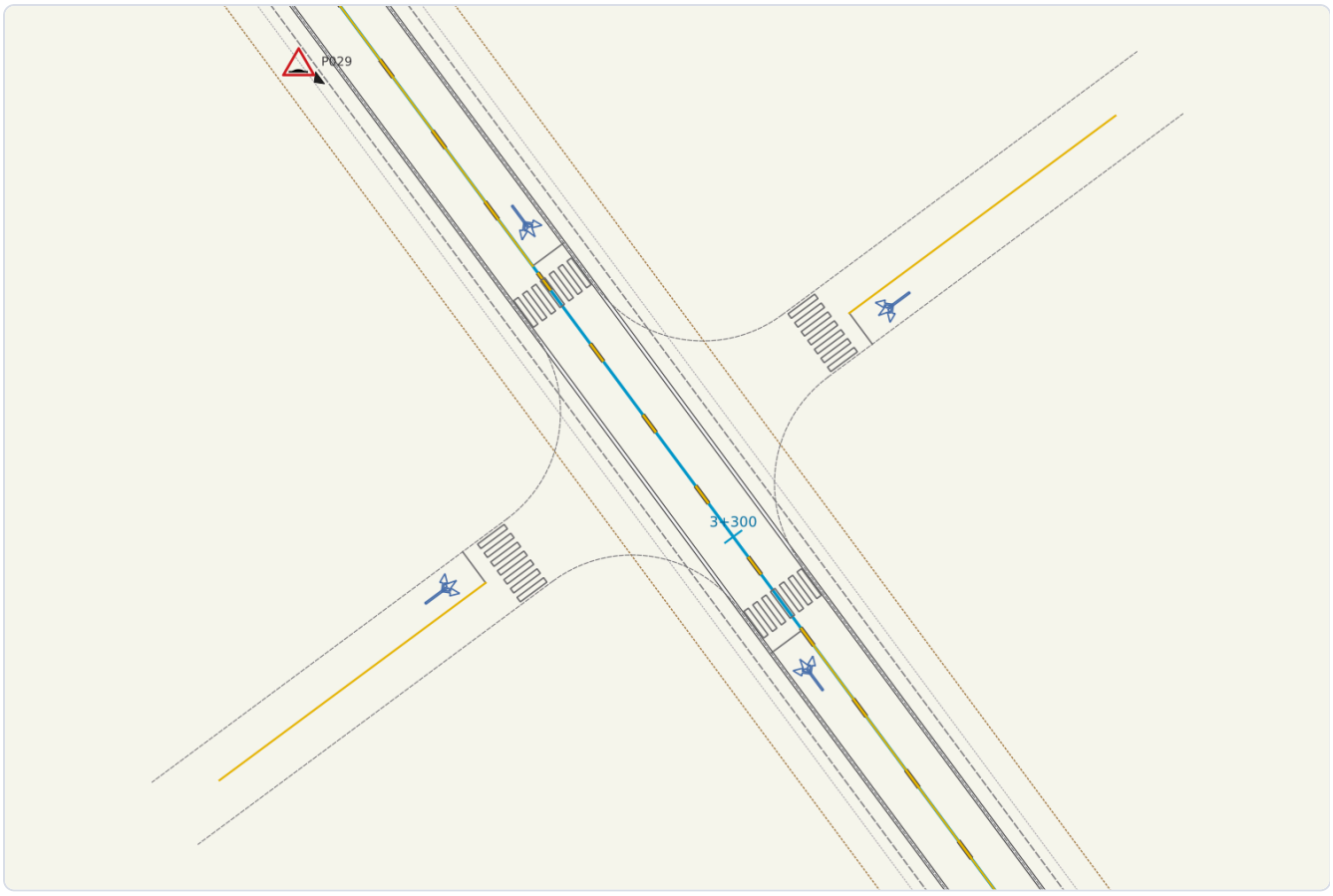


Figure 13. A signalised crossroads in the village at CH 3+290: R 12 m kerb returns, BM02 crossings, TM01 stop lines, LM24 and AM07 arrows on every approach, with the W46 signs proposed on our road ahead of it, off the figure.

Visibility splays

Every junction kit carries its **visibility splays** (RDM 1.3 §9.5.4), on by default: the sight triangles in which nothing may block the view between a driver waiting on the minor road and traffic on the main road, on both sides of the junction.

Splay	Apex on the minor road	Along the main road
Approach / give way (Figure 9.11)	20 m back from the main road's lane edge	L_A, Table 9.7: 95 m at 50 km/h, 140 m at 70, 190 m at 85, 215 m at 100
Stop (Figure 9.12)	3.0 m back from the lane edge	L_S, Table 9.8: 160 m at 50 km/h, 225 m at 70, 275 m at 85, 320 m at 100

The apex sits on the minor road's centreline, measured along the minor road, so a skewed junction keeps the driver's real position; the far ends sit on the main road's centreline and follow its curvature. Speeds between the table values are interpolated. The main road's design speed comes from its alignment (our road, or the other alignment where our road is the minor road); type it as **Main road speed** where the alignment has none or the main road is a clicked direction, otherwise 80 km/h is assumed and flagged. The tables are in the design criteria file (`junction_sight`), so another standard can replace them. RDM 1.3 asks for the approach splays and, where they cannot be achieved, at least the stop splays.

Where **our road is the minor road**, its own approach gets the splay of RDM 1.3 Figure 9.13 as well (orange dashed): the area between our approach lane and the sight lines from drivers up to one stopping sight distance back (at our road's design speed) to the give way line and its sign. On a bend it reaches across the

inside of the curve; the checks say how far from the lane centre it must be kept clear, and it is checked against the obstruction layers with the others.

RFD checks the splays two ways:

- **On the profile**: a driver's eye at 1.05 m must see a vehicle 0.6 m high (RDM 1.3 Table 3.13) over the main road's design profile for the full splay length. A crest that hides it is a check for the approach splay and an issue for the stop splay.
- **Against QGIS layers**: tick the layers that hold obstructions (buildings, trees, fences, walls, kiosks, survey features or a digitised layer over imagery) in **Obstruction layers** and press **Check splays**. Every feature inside a splay is listed against its junction, and in the report's furniture checks: inside a stop splay as an issue, inside an approach splay only as a check. The layers are remembered with the project, and the report re-runs the check.

The splays are drawn green (approach) and red (stop), dashed, and go to the DXF on `RSD-JN-SPLAY-A` and `RSD-JN-SPLAY-S`. Untick **Visibility splays** to place a kit without them.

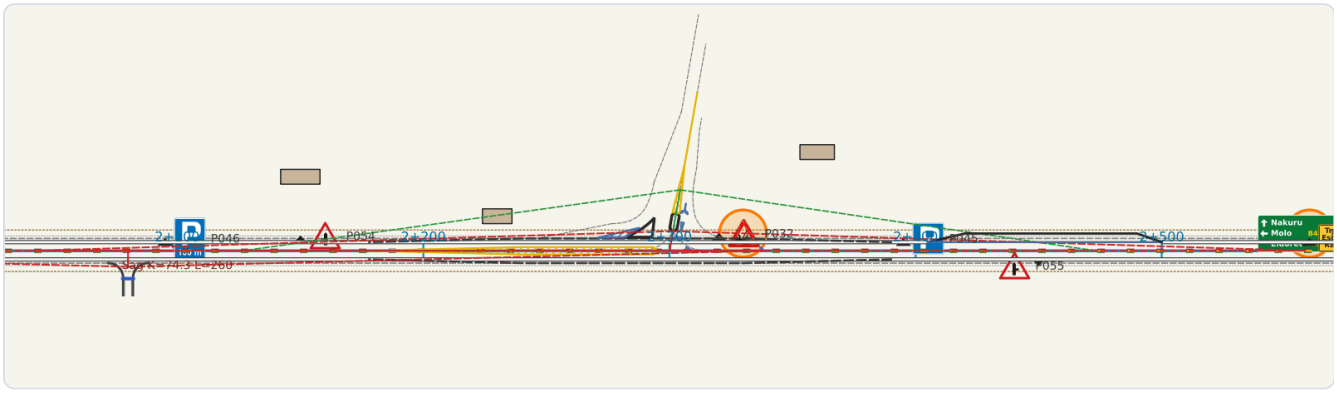


Figure 14. The type A-1 junction at CH 2+300 with its splays for 80 km/h on the main road: approach (green, 20 m back, 173 m each way) and stop (red, 3 m back, 258 m each way), checked against a sample buildings layer. The building inside the approach splay is listed as a check.

Private accesses

Choose the type **Private access** (RDM 1.3 §9.11.16, Figure 9.33), set its **width** (at least 3 m), **return radius** (6 m or more for the turning traffic) and the distance **to the boundary** (at least 10 m from the road edge to the fence or boundary line), then click the access point on our road and a point up the access, so it takes the skew. RFD draws:

- the formation edges, the paved width plus 0.5 m shoulders, leaving the road on returns of the given radius from the outer shoulder edge (the ETW where the corridor has no shoulder code);
- the paved edges from the mouth back to the boundary line, then a 3 m taper to match the existing access;
- an indicative traversable drainage pipe across the mouth, formation width plus 0.5 m each end;
- the **stop** visibility splays on both sides (3 m back, Table 9.8): the manual asks for the stop-condition visibility at accesses. Its text points to "Section 4.5", which is Walkways; the stop conditions are in §9.5.4.

The schedule lists the access with its pavement area and edge length, and the pipe. The furniture checks flag an access narrower than 3 m (issue), a radius under 6 m, a run under 10 m, and any private access on a class A, B, UA or UC road, where RDM 1.3 Tables 2.3 and 2.4 ask for full access control (no direct private accesses) as the desirable standard: group accesses or use a service road where you can. The class is taken from **Road class** in Propose markings on the Linear tab.

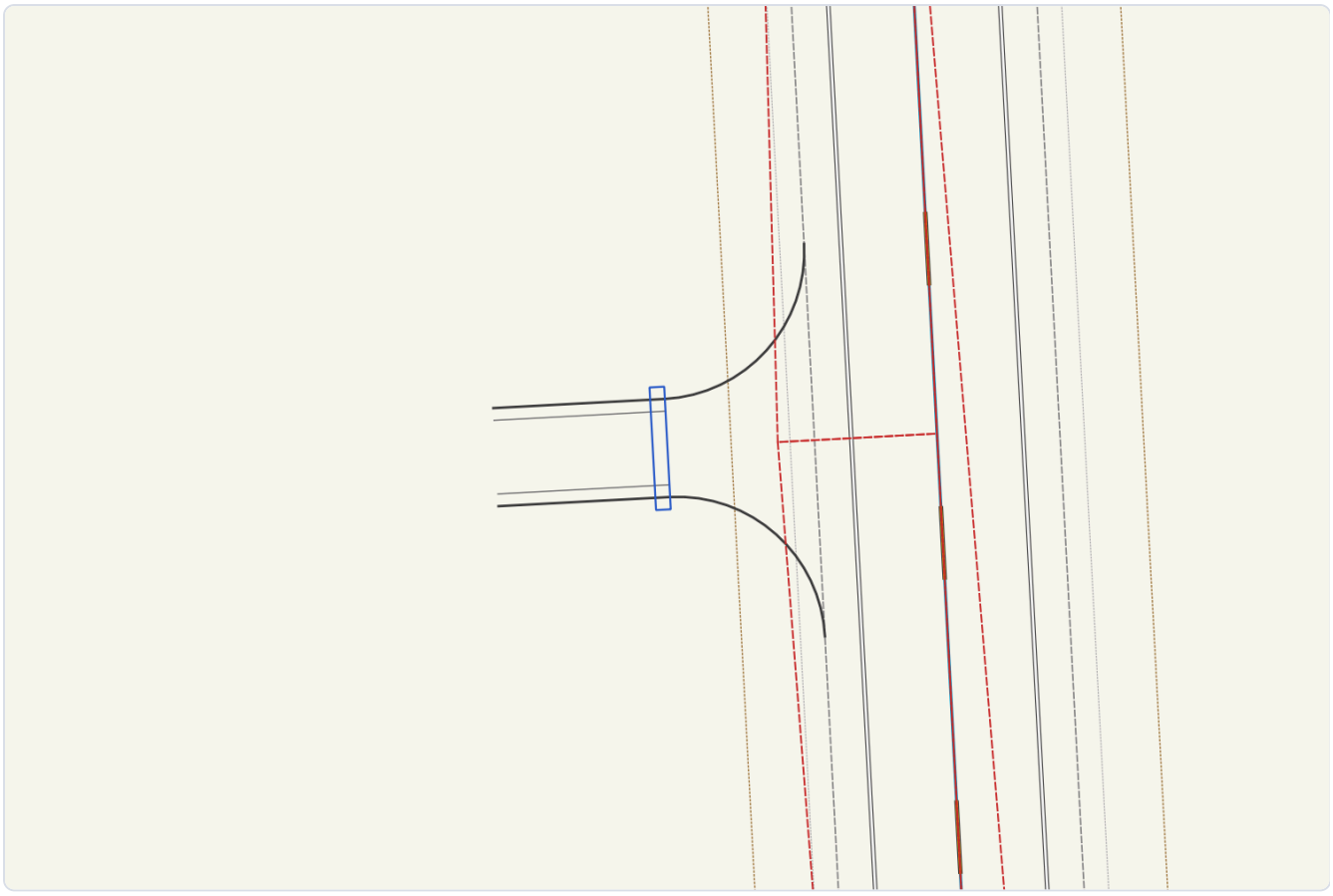


Figure 15. A 3 m private access at CH 2+080 on the right: 6 m returns, 0.5 m shoulders, paved to the boundary 10 m back with a 3 m taper, the pipe across the mouth (blue) and the stop splays (red, dashed).

Roundabouts

Choose the type **Roundabout** (RDM 1.3 Chapter 10; markings RDM 6.1 Figures 7.14 to 7.16) and set the **central island** diameter, the **inscribed circle** diameter (ICD; by default the Table 10.1 minimum for that island and the 15.5 m articulated design vehicle) and the entry and exit **radii** of the kerb returns. Then:

1. Click the centre on our road (it snaps to the centreline). Our road gives two arms where it crosses the inscribed circle, and any other alignment of the LandXML crossing the circle gives its own.
2. Click the direction of any other arm (a side road without an alignment), as many as needed; the preview shows the roundabout with the arm under the mouse.
3. Right-click or press Enter to place it.

When a roundabout is placed, and whenever markings are proposed again, our road's longitudinal markings and studs are cut back: centre lines to beyond each splitter's lead-in and its LM24, edge lines and studs to the end of the entry flare. Runs that cross the roundabout are split in two.

RFD draws the central island (and a mountable apron edge where one is set), the outer kerb of the circulatory carriageway with the entry and exit returns, flared to the approach width, and on each arm a kerbed splitter island with a hatched lead-in, the TM07 give way line across the entry with the BM07 triangle 2.5 m behind it, the TM04 line across the exit and the LM24 centre line on the approach. Kenya drives on the left, so traffic enters on the left of each arm and circulates clockwise. It proposes an R2 Give Way at every entry, an M5 Keep Left on every splitter nose and a W24 chevron on the central island facing every entry, and W17 Roundabout Ahead on our road's approaches at the advance distance for their speed.

The furniture checks (RDM 1.3 Chapter 10): three to five arms, at least 60° apart (10.4.3); a central island of at least 4 m (10.5.2.1); an ICD of at least the Table 10.1 minimum and not over 100 m (10.5); a circulatory

carriageway of about 6.5 m or more and not over 15 m (10.5.2); kerb returns of adjacent arms that run into each other; an ICD between 28 and 36 m, where a compact roundabout should be considered; and on our approaches, the entry seen from the stopping sight distance over the profile, so that it does not sit on a sharp crest (10.4.4). The **entry path radius** of the ahead movement (10.6.3.5, Figure 10.14) is checked at every entry on a simplified fastest path: a smooth curve from 50 m back, 1 m off the centre line, through 1 m off the nearside kerb at the give way line, 1.5 m outside the central island and out of the opposite exit; the tightest 25 m of it near the give way line must not exceed 100 m (70 m at a compact urban roundabout). A small island in a large ICD with radial arms deflects little: stagger the arms (Figure 10.17) or enlarge the island. Confirm the paths on the junction design. The manual's other rule of thumb, a circulatory width of 1.0 to 1.2 times the entry width, is not checked either, as Table 10.1 widths for the design vehicle exceed it on single-lane roundabouts; the width is listed for your judgement. Mini roundabouts (no kerbed island) are not drawn.

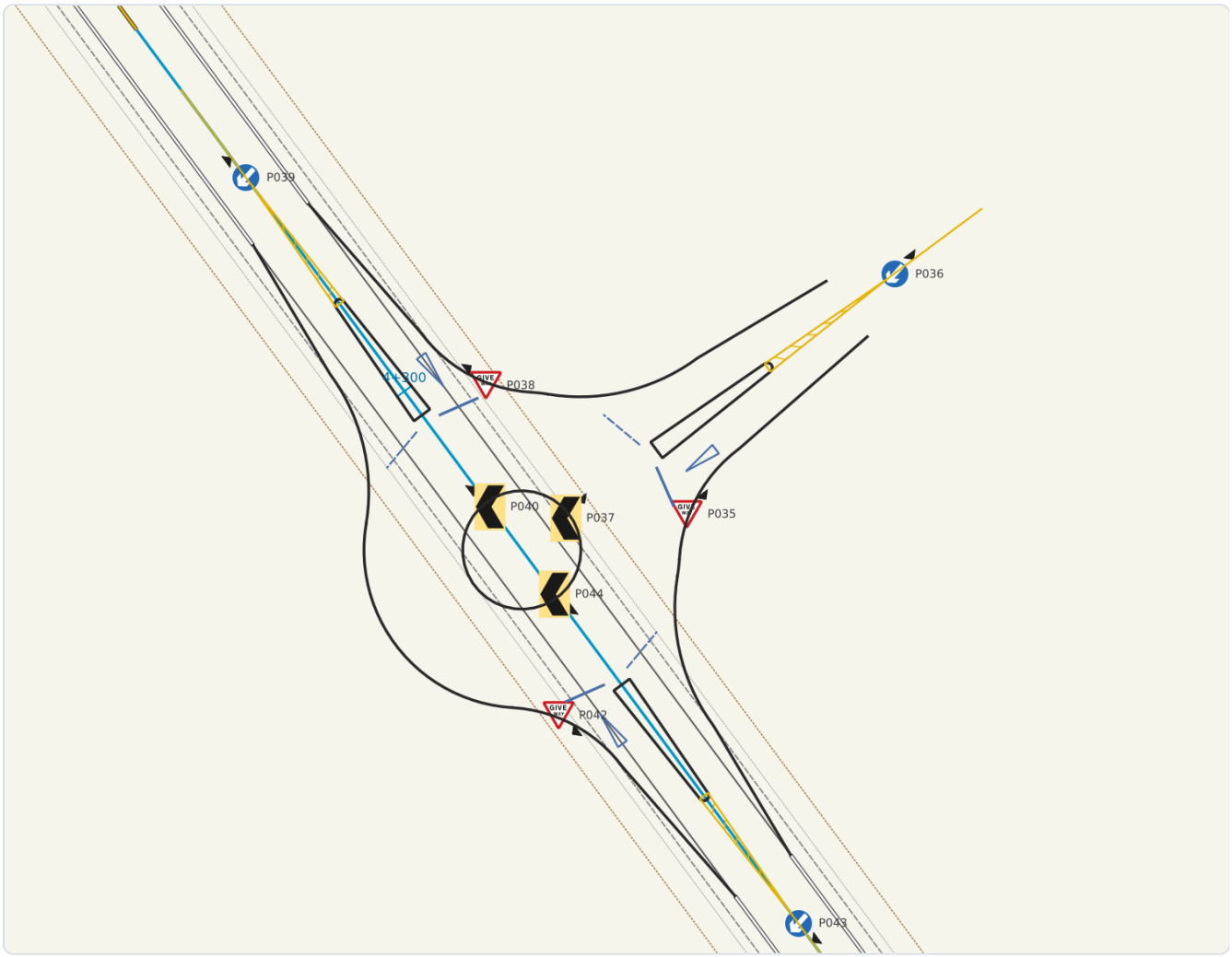


Figure 16. A three-arm roundabout at CH 4+320: 12 m central island, 32 m ICD (Table 10.1), splitter islands with hatched lead-ins, give way markings on the entries, and the R2, M5, W24 and W17 signs.

Bus bays

Choose the type **Bus bay** (RDM/1/3/3/01) and press **Place on map**. Click where the bay starts on the side of the road it serves, then where it ends: the clicks set the side and the stopping length (at least 5 m; 25 m takes more than one bus). RFD adds, in the direction of travel on that side (Kenya drives on the left):

- **Entry taper** of 30 m, or 25 m where the design speed is 50 km/h or less, and an **exit taper** of 18 m, both smooth, before and after the bay.

- **Kerb** along the widened edge, 4.0 m deep along the bay; flush on the tapers and raised along the bay with 2 m ramped ends (the raised length is listed apart).
- **Loading platform** 1.0 m wide behind the kerb along the bay, the **LM05** separation line (1 m marks, 1 m gaps) along the carriageway edge, and an indicative 6 m **shelter** position behind the platform.
- A **WSCM-I3 Bus Stop** sign at the start of the bay, proposed (RDM 6.2 has no bus stop sign).

Bays serving opposite directions closer than 60 m centre to centre are flagged in the furniture checks (note 4 of the drawing).

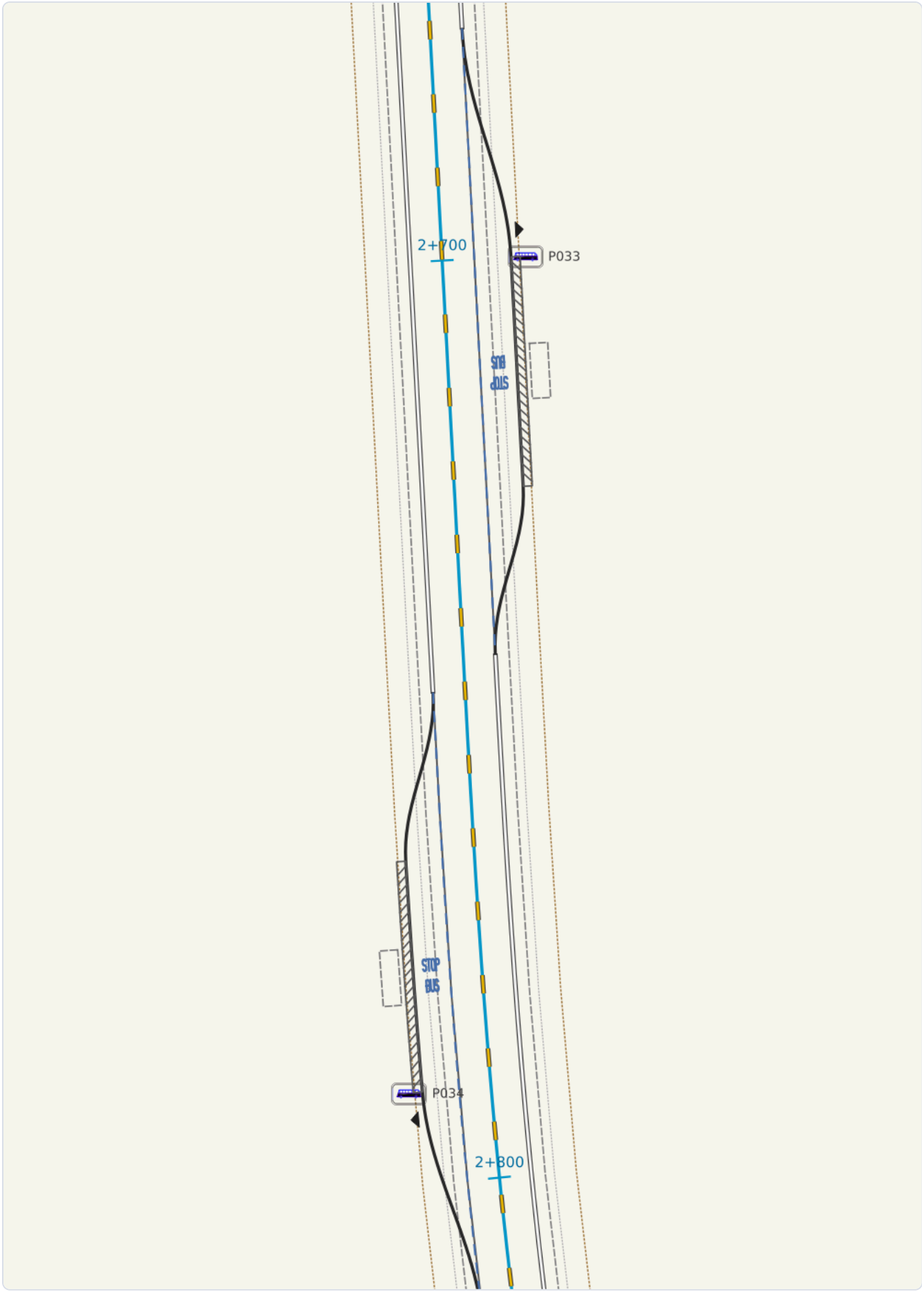


Figure 17. Two 25 m bus bays in the village, one each way and 65 m apart centre to centre: entry and exit tapers, kerb, platform, LM05 line, shelter positions and the WSCM-I3 signs.

Truck parking bays

Choose the type **Truck parking bay** (RDM/1/3/3/03) and place it like a bus bay: click where the full-width bay starts on the side of the road it serves, then where it ends. The drawing shows a 70 m bay, which takes the four to five heavy vehicles RDM 1.3 §13.2.4.1 asks for; it varies with the design. RFD adds:

- a straight **15 m entry taper** and a straight **10 m exit taper** in the direction of travel, with the bay **3.5 m** beyond the carriageway edge;
- the edge of the widened pavement (`BAYEDGE` ; the drawing shows no kerb) and the white **LM05** separation line, 0.2 m wide, 1 m marks and 1 m gaps, along the carriageway edge from the start point to the end point;
- **I15 Lay-by** at the start of the entry taper, facing oncoming traffic, and **I14 Lay-by Ahead** 300 m before it (RDM 6.2 §6.4.1.1 allows up to 500 m; move it as needed), both proposed.

The furniture checks flag a bay shorter than 70 m, and truck bays more than 30 km apart in one direction (RDM 1.3 §13.2.3.1). Bays should not be sited where visibility is restricted (§13.2); that is not checked yet, so look at the sight distance on the long section.

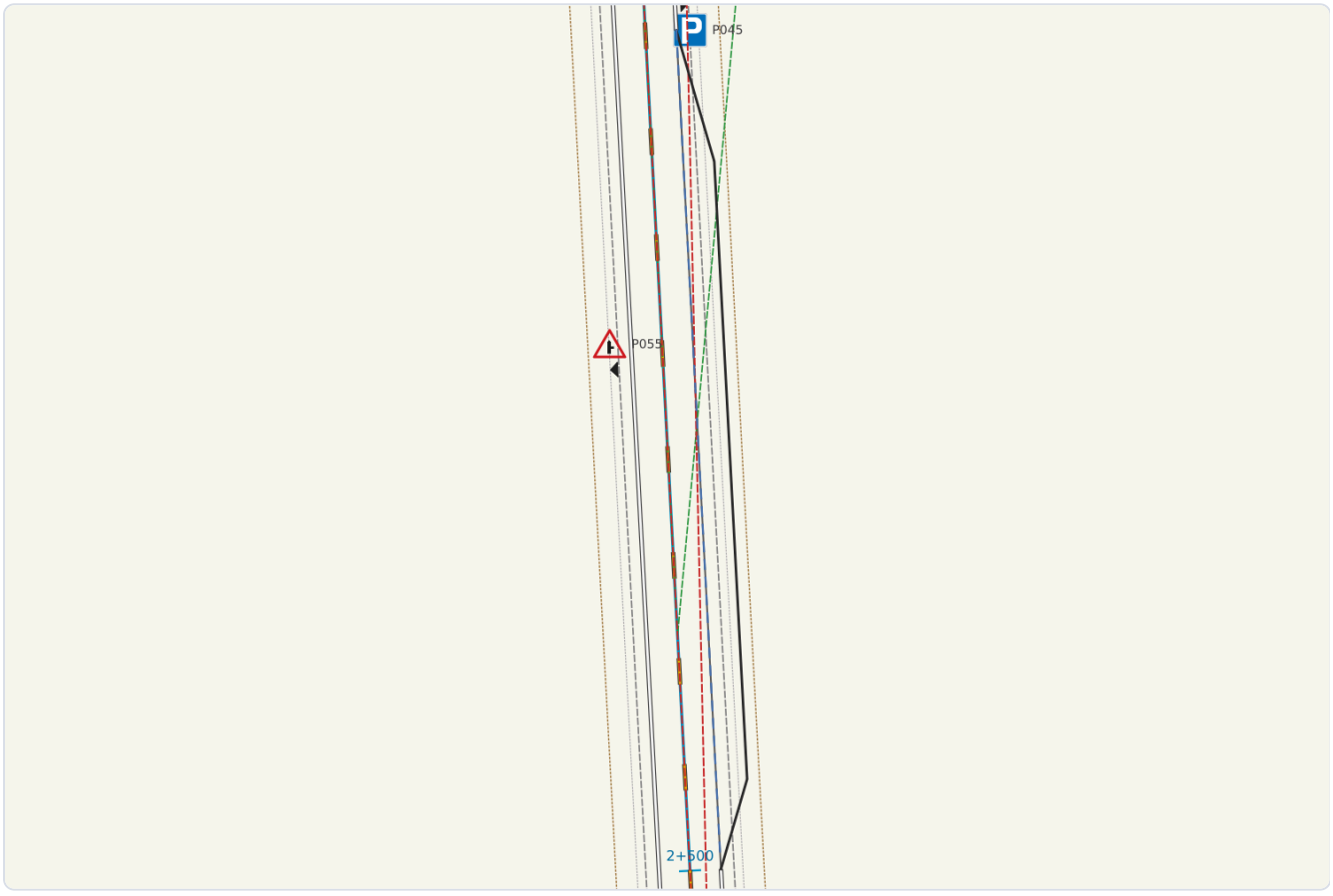


Figure 18. A 70 m truck parking bay at CH 2+420 on the straight before the village: straight 15 m and 10 m tapers, the widened edge, the LM05 separation line and the I15 sign at the start of the entry taper (I14 is 300 m back, off the figure).

Climbing lanes

Choose the type **Climbing lane** (RDM 1.3 §6.6, RDM/1/3/3/02). Give the year-10 **AADT** if you have it and press **Propose climbing lanes from the profile**. RFD follows the trucks along the design profile, vertical curves included: each metre on an up-grade steeper than 3 % uses up a share of its RDM 1.3 Table 6.6 length (900 m at 4 %, 800 m at 5 %, 700 m at 6 %, 600 m at 7 %, 500 m at 8 %), and flatter ground gives it back (fully over about 300 m of level road). Where the allowance runs out, a lane is proposed:

- on the side of the traffic climbing the grade, from where the Table 6.6 length is reached to 200 m past the end of the grade, for the trucks to merge;
- with 100 m entry and exit tapers, as wide as the through lane (reduced by 0.25 m where it is 3.25 m or more, §6.6.3), the widened pavement edge with its tapers (drawn as for a truck parking bay), the LM26 edge line on it and a broken LM03 lane line along the old edge;
- with WSCM-I1 (start of climbing lane) at the entry taper and WSCM-I2 (end of climbing lane) where the exit taper starts.

With an AADT under 2,000 pcu none are proposed (§6.6.2); from 2,000 to 6,000 pcu the lane is listed as one to consider where passing is limited, and above 6,000 pcu as normally required. The steep descent of the demonstration road is 6.75 % over 600 m, just inside its 625 m limit, so nothing is proposed there. You can also place a lane by hand: click where the full-width lane starts on the climbing traffic's side, then where it ends, and the tapers are added. Consecutive steep grades with only a short, flatter break between them count together, and lanes less than 400 m apart are joined into one. The recovery rate is indicative: review the extent against a truck speed profile where it matters.

Descending lanes, brake check areas and escape ramps

Long, steep descents are where loaded trucks lose their brakes. RDM 1.3 gives three measures: a **descending lane** for slow trucks (§6.6.4), a **brake check area** at the top where drivers stop, check their brakes and select a low gear (§12.5), and a **truck escape ramp** where a runaway truck can leave the road and be stopped in an arrester bed (§12.7). Choose the type **Descending lane**, **Brake check area** or **Escape ramp** and press **Propose … from the profile**, or place one by hand as a bay (two clicks on the side of the downhill traffic).

RFD reads every descent from the design profile, in each direction of travel: downgrades over 3 %, with easier stretches up to 150 m bridged so a short flattening does not split one descent in two. Down each descent it follows a **runaway truck**: 40 km/h at the top, gaining speed with the grade less 1 % rolling resistance (v^2 grows by 2 g (G − 0.01) per metre), to 140 km/h at most.

- **Descending lane**: where the upgrade in the other direction warrants a climbing lane (the same Table 6.6 lengths and AADT thresholds as above) and the descent is over 1000 m. Drawn like a climbing lane on the downhill traffic's left, with I12 proposed.
- **Brake check area**: at the top of a descent that drops 100 m or more, or runs 1000 m or more at 5 % or steeper, when the number of **trucks / day** given on the tab is about 500 or more. A 100 m bay, 3.5 m deep with 60 m tapers, ending 100 m before the top; I15 at the bay with I14 500 m ahead, and W30 (steep descent) beyond it.
- **Escape ramp**: once the road has dropped 130 m, before a **singular point** the runaway truck cannot take: a curve whose radius is too tight for its speed with a side friction of 0.10, a town at 50 km/h or less, or the end of the road. The ramp goes on the last tangent before it, on the downhill traffic's left (Kenya drives on the left).

The arrester bed is as long as Eq 12.1 asks for the truck's speed at the ramp: $L = V^2 / (254 (R + G) / 100)$, with V in km/h, G the ramp grade in % (+ up) and R the rolling resistance of the bed material from Table 12.7 in % (loose crushed aggregate 5, loose gravel 10, sand 15, pea gravel 25). At 140 km/h on a 10 % ramp of loose gravel that is 386 m. The ramp is drawn in plan, for Civil 3D: the road edge widens over a 50 m taper to the 8 m ramp, which departs at 4° to the road; 30 m of paved entry, then the arrester bed (1.0 m deep) to the end mound. Where the road beyond the tangent bends towards the ramp's side, a straight ramp leaving near the curve would run back across the road. RFD then has the ramp leave early enough to lie alongside the tangent, and turns it further from the road, a degree at a time up to 12° (`max_angle`), so its road-side edge stays 10 m clear of the shoulder (`road_clear`). Where even that is not enough the ramp stops short and the bed check reports it: on a hillside a steeper ascending ramp (its **grade** in the Properties table) shortens the bed Equation 12.1 asks for. E1 (escape ramp ahead) at 1000 m and 500 m, I33 at 200 m, I32 at the ramp and a P14 no-

parking at its mouth are proposed. The ramp's edges go to the feature-line export at the ramp grade from the road-edge level.

The furniture checks flag a ramp on a curve, a ramp narrower than 3.6 m or wider than 12 m, a bed shorter than Eq 12.1 needs for the speed at that point and material, and a ramp site with no ramp placed within 500 m. The demonstration road's descent drops only 39 m, so nothing is proposed there; Figure 19 shows a 160 m ramp placed by hand.

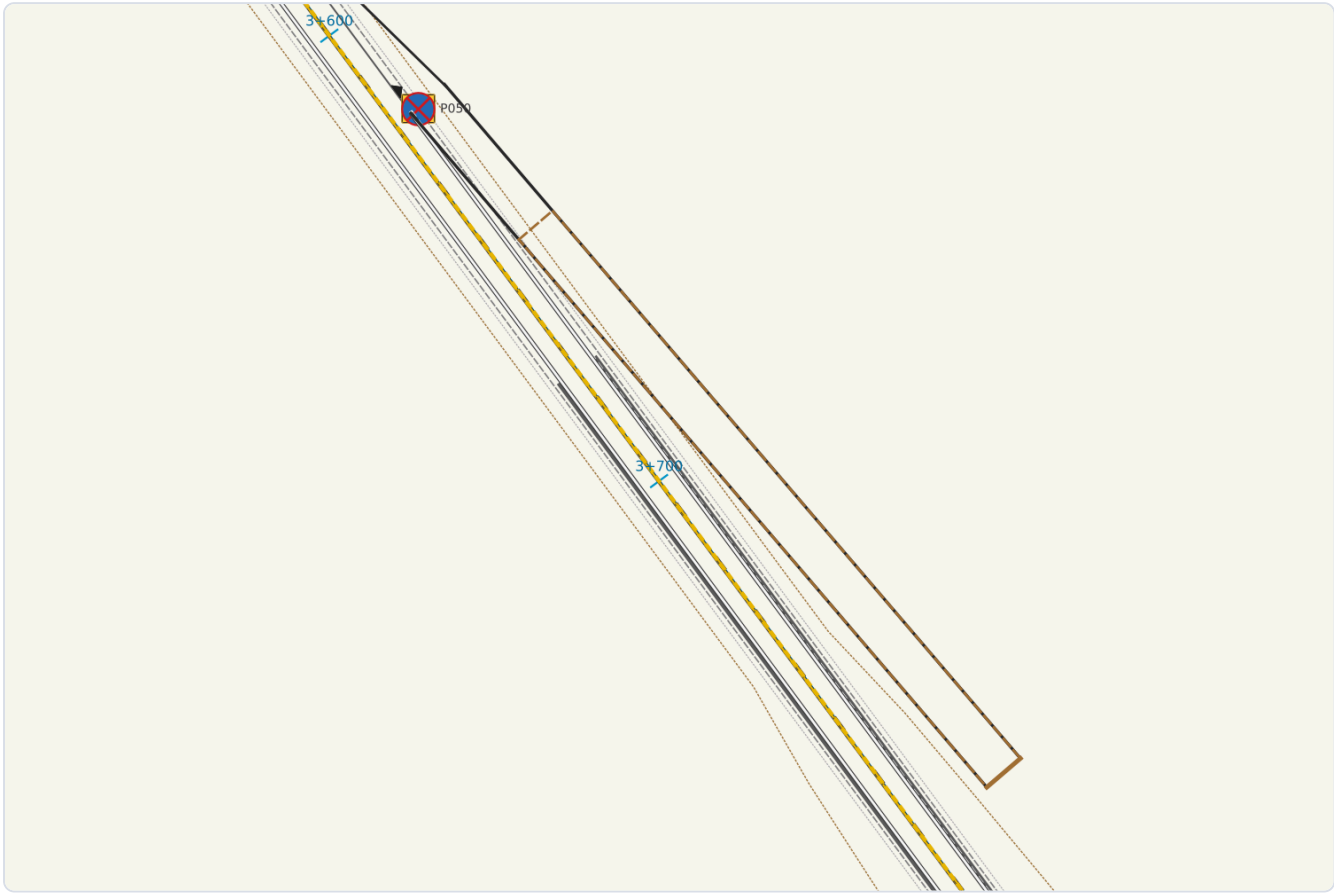


Figure 19. A truck escape ramp placed by hand at CH 3+620 on the demonstration road's descent, traffic running down the figure on a straight: the 50 m taper widening the road edge, the ramp's edges at 4° to the road, the arrester bed (dashed) after 30 m of paved entry, and the end mound.

Where the speeds and grades of a real descent call for it, review the proposal against a truck speed profile and the site: the runaway model is deliberately simple, and the ramp's vertical design is done in Civil 3D.

Properties, handles, undo and snapping

- **Properties.** Select a junction, bay, lane or ramp in the list: the **Properties** table shows its dimensions (tapers, depth, width, bed length, grade, material, radii, island sizes ...) with the RDM drawing's value beside each. Change a value, give the reason and press **Apply properties**: the item is rebuilt, and the change is listed as a **departure** in the furniture checks with its reason (Info), or as a Check when no reason is given.
- **Handles.** With **Move**, click within 8 m of a bay, lane or ramp's start or end and drag it along the road to change its length; a click anywhere else on a piece moves the whole item.
- **Undo / Redo** (beside the project buttons, 30 steps) take back or repeat placing, moving, removing and editing signs, lines, junctions, bays and lanes, the property changes and the proposals from the profile.
- **Snapping to a road layer.** Where our road joins a road that is not in the LandXML but is drawn in a QGIS line layer (a road network, a county road layer), pick that layer as the **Main road**. The direction you click

then follows the layer's nearest segment within 25 m of the junction, so the main-road pieces line up with it without careful aiming.

Widening table for Civil 3D

Bus bays, truck parking bays and climbing lanes widen the road, which belongs in the Civil 3D corridor. The report's Excel workbook has a sheet **Widenings** (table `RFD_Widenings`), one row per bay or lane, with what the Civil 3D widening needs: side, the chainages where the widening starts, reaches full width, leaves full width and ends, the entry and exit taper lengths, the width, the widened area and the kerb length.

Round trip with Civil 3D

Bays and lanes are stored by chainage, side and dimensions, not coordinates, so they survive a redesign. The round trip:

1. Build the widenings in the Civil 3D corridor from the Widenings table, moving the **ETW** out over the tapers and the bay or lane.
2. Export the LandXML again to the same file, reopen the project and press **Recompute all chainages**: signs, runs, junctions, bays and lanes rebuild on the new alignment and corridor.
3. Make the report. The furniture checks compare, at every corridor section inside each bay or lane, the corridor's ETW with the edge RFD planned:

- **not in the corridor yet** (info) while the corridor's ETW is not widened there;
- **matches the corridor within 0.3 m** (info) when it is;
- a **check** giving the largest difference, the section and both widths when the corridor and the placed bay disagree by more than 0.3 m.

The planned edge is measured from the ETW *before* the widening: the line between the nearest corridor sections outside the bay. So a bay rebuilt on a widened corridor stays where it was instead of widening again. The bay only switches to that line where the corridor stands out by at least half the bay's depth, so ordinary curve widening is left alone. The check uses the corridor's sections, so it is as fine as the section spacing exported from Civil 3D.

PART 4

Outputs

The inventory for the QTO, the road furniture report and its checks, and the route into Civil 3D drawings.

17 Inventory for the QTO

Export inventory (Excel + CSV) writes `*_Inventory.xlsx` with named Excel Tables, ready to link into a QTO workbook, and a CSV of the sign faces:

Table	One row per	Main columns
RSD_Signs	sign face	Post, chainage, side, offset, edge and clearance, facing, code, description, size, legend, grade, design speed, UUIDs
RSD_Posts	post	Post ref, chainage, side, post type, foundation, number of faces
RSD_Linear	linear run	Item, pattern, chainages, length, side, offset, quantity, painted area, terminals
RSD_Quantities	item	Faces by code and size, posts and foundations by type, markings in m and m², studs, barriers and terminals; live formulas over the other tables

There are no rates: the tables feed the separate QTO and Bill process.

18 Road furniture report

Road furniture report (PDF + PNG sheets + Excel) asks for the plan scale (Auto, 1:500 to 1:5000, or no plan sheets) and Prepared / Checked / Approved by, kept with the project. It writes an A3 landscape PDF, a PNG per plan, long-section and strip sheet, and an Excel workbook. Every page sits in the same frame with a title block; to add a logo at the top right, point the QGIS setting `RoadFurnitureDesigner/report_logo` at an image file. The demonstration road's report is 21 pages.

Plan layout sheets

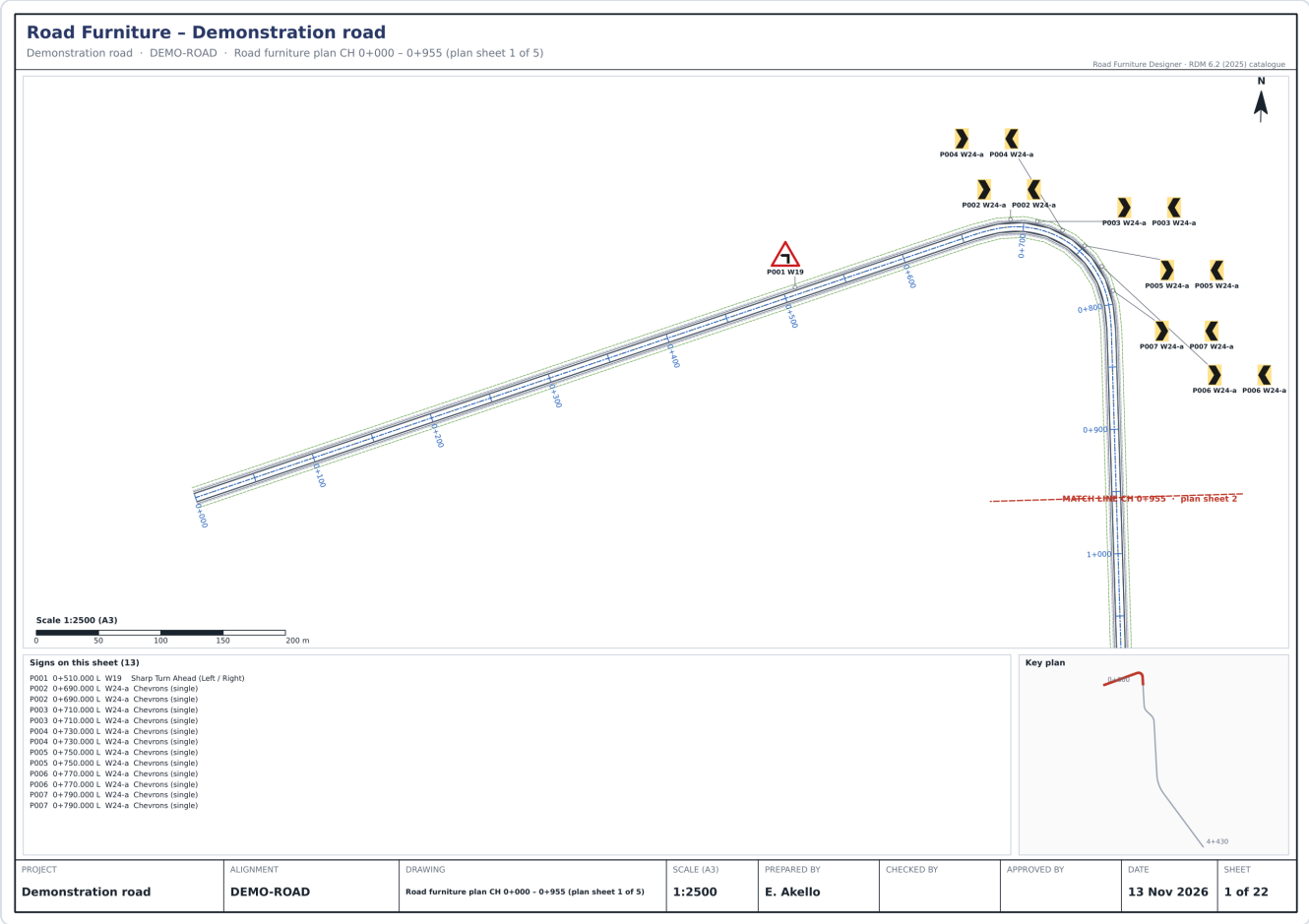


Figure 20. Plan sheet 1 at 1:2500: corridor edges, chainages, markings, studs and barriers in their line styles, signs upright beside the road with leaders to their posts, match lines, north arrow, scale bar, the sheet's sign list and a key plan.

- Each sheet is turned so the road runs left to right. Sheet lengths adapt: on straights a sheet covers about 950 m at 1:2500; on tight curves it is shortened so the road and the signs still fit.
- Signs are drawn upright at 10 mm beside the road with a leader to the post; a sign and its plate stack, back-to-back faces sit side by side, and symbols are moved until they clear one another.
- Linear furniture is drawn in its line style and colour; proposals carry a faint orange halo. The LandXML's other alignments are drawn and named.

Long-section sheets

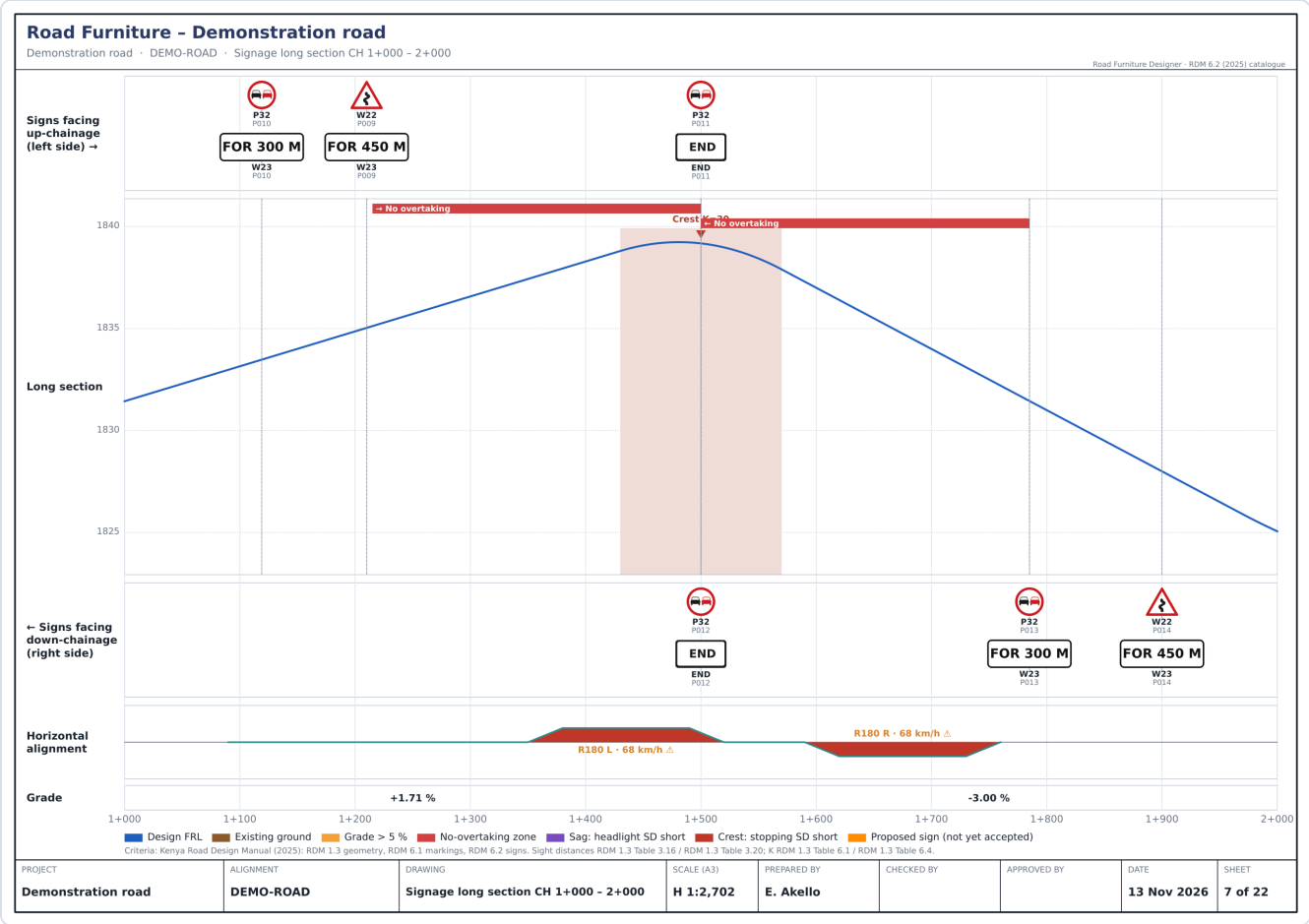


Figure 21. Long section CH 1+000 to 2+000: signs for each direction above and below the profile, the no-overtaking bars over the crest, the short crest's stopping-sight-distance band, the curvature band with the R 180 m bends and their safe speed, and grades.

Strip diagram

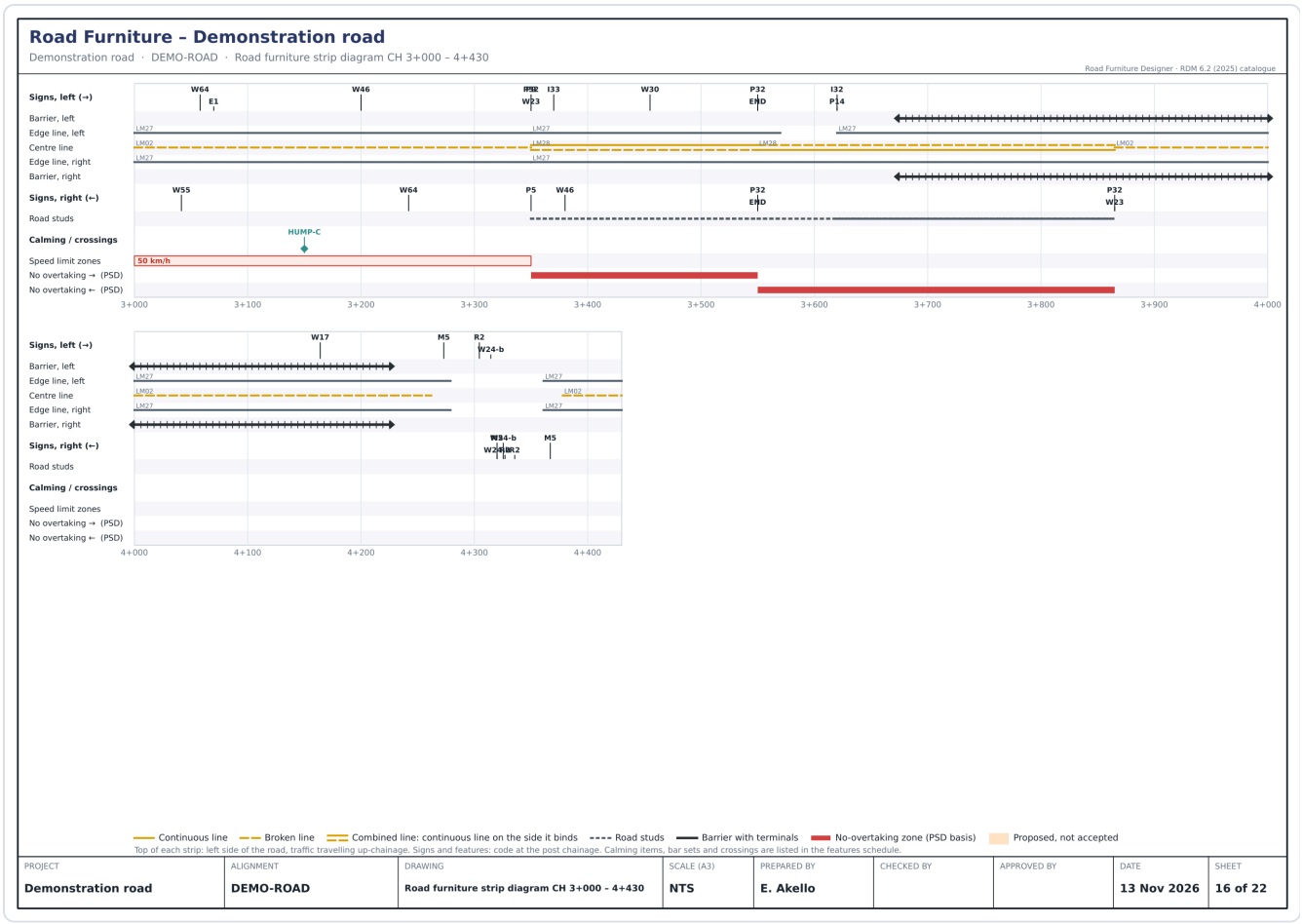


Figure 22. Strip diagram CH 3+000 to 4+430: signs for each direction, barriers, edge and centre lines, studs, the hump and crossing, the 50 km/h zone and the no-overtaking zones from the passing sight distance.

A straight-line diagram, 1 km per strip and three strips per page, of everything along the road against one chainage scale, so signs and markings can be checked by eye against the no-overtaking zones they follow. The combined line shows which side binds; proposed items have a light orange band.

Schedules and workbook

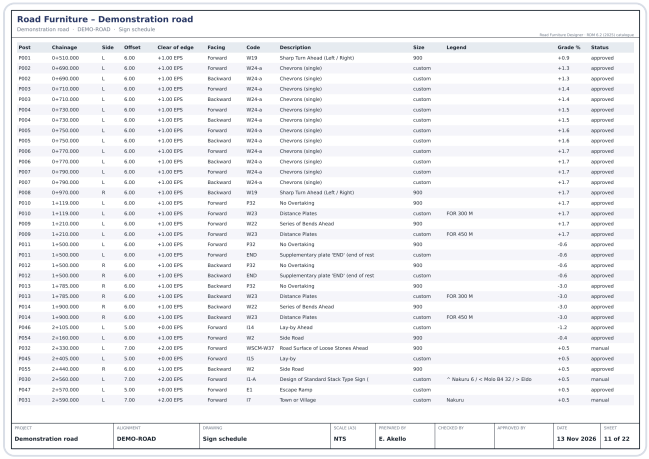


Figure 23. Sign schedule.

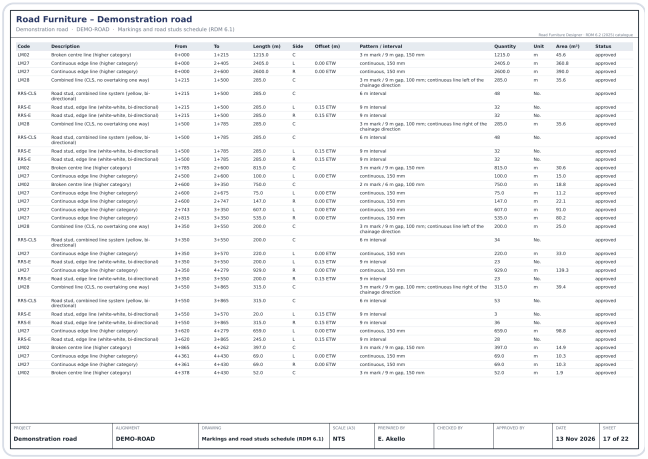
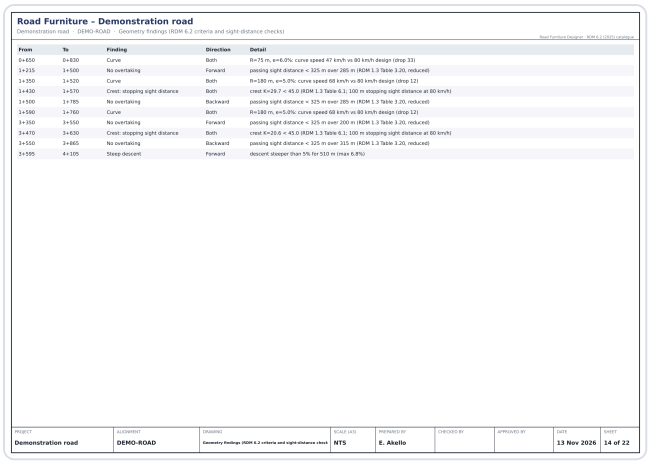


Figure 24. Markings and road studs schedule.



Road Furniture – Demonstration road

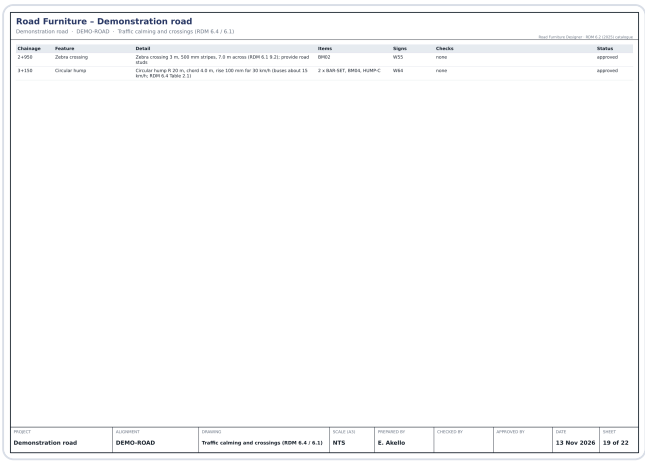
Demonstration road · DEMO-ROAD · Geometry findings (RDM 6.2 criteria and sight-distance checks)

Road Furniture Designer · RDM 6.2 (2025) catalogue

From	To	Finding	Direction	Detail
0+650	0+830	Curve	Both	R=75 m, e=6.0%: curve speed 47 km/h vs 80 km/h design (drop 33)
1+215	1+500	No overtaking	Forward	passing sight distance < 325 m over 285 m (RDM 1.3 Table 3.20, reduced)
1+350	1+520	Curve	Both	R=180 m, e=5.0%: curve speed 68 km/h vs 80 km/h design (drop 12)
1+430	1+570	Crest: stopping sight distance	Both	crest K=29.7 < 45.0 (RDM 1.3 Table 6.1; 100 m stopping sight distance at 80 km/h)
1+500	1+785	No overtaking	Backward	passing sight distance < 325 m over 285 m (RDM 1.3 Table 3.20, reduced)
1+590	1+760	Curve	Both	R=180 m, e=5.0%: curve speed 68 km/h vs 80 km/h design (drop 12)
3+350	3+550	No overtaking	Forward	passing sight distance < 325 m over 200 m (RDM 1.3 Table 3.20, reduced)
3+470	3+630	Crest: stopping sight distance	Both	crest K=20.6 < 45.0 (RDM 1.3 Table 6.1; 100 m stopping sight distance at 80 km/h)
3+550	3+865	No overtaking	Backward	passing sight distance < 325 m over 315 m (RDM 1.3 Table 3.20, reduced)
3+595	4+105	Steep descent	Forward	descent steeper than 5% for 510 m (max 6.8%)

PROJECT	ALIGNMENT	DRAWING	SCALE (A3)	PREPARED BY	CHECKED BY	APPROVED BY	DATE	SHEET
Demonstration road	DEMO-ROAD	Geometry findings (RDM 6.2 criteria and sight-distance check	NTS	E. Akello			13 Nov 2026	14 of 22

Figure 25. Geometry findings.



Road Furniture – Demonstration road

Demonstration road · DEMO-ROAD · Traffic calming and crossings (RDM 6.4 / 6.1)

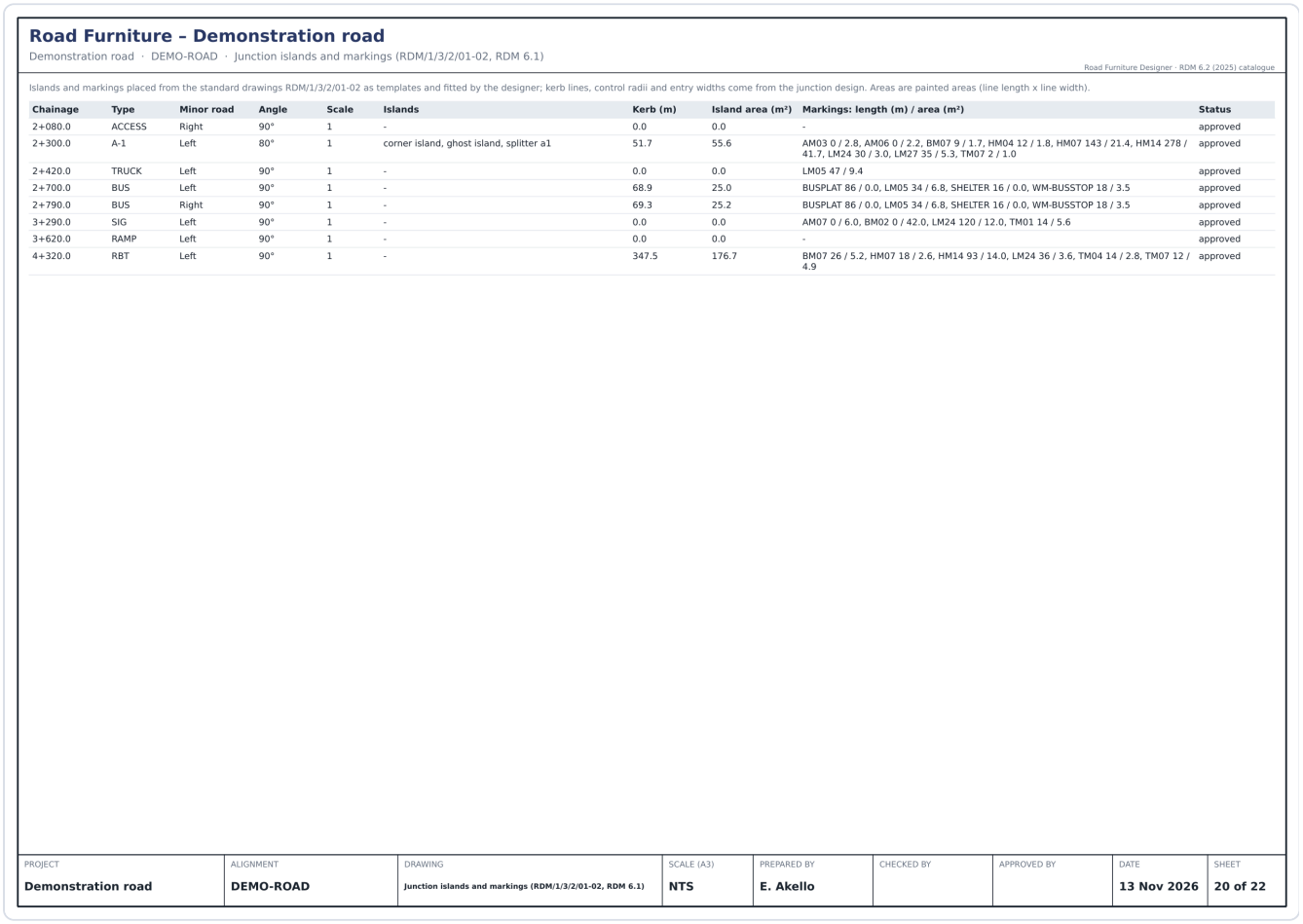
Road Furniture Designer · RDM 6.2 (2025) catalogue

Chainage	Feature	Detail	Items	Signs	Checks	Status
2+050	Zebra crossing	Zebra crossing 3 m, 500 mm stripes, 7.0 m across (RDM 6.1 9.2); provide road studs	BM02	W55	none	approved
3+150	Circular hump	Circular hump R 20 m, chord 4.0 m, rise 100 mm far 30 km/h (buses about 15 km/h; RDM 6.4 Table 2.1)	2 x bAN-SAT, BM04, HUMP-C	Wb6	none	approved

PROJECT	ALIGNMENT	DRAWING	SCALE (A3)	PREPARED BY	CHECKED BY	APPROVED BY	DATE	SHEET
Demonstration road	DEMO-ROAD	Traffic calming and crossings (RDM 6.4 / 6.1)	NTS	E. Akello			13 Nov 2026	19 of 22

Figure 26. Traffic calming and crossings.

After the sign schedule and the geometry findings come the markings and studs schedule, the barrier schedule (with the basis of each run), traffic calming and crossings, the junction islands and markings (each junction with its kerb length, island area and painted length and area by marking code), the linear quantities and the furniture checks. The Excel workbook has the sheets Signs, Findings, Horizontal curves, Vertical curves, Markings, Barriers, Features, Junctions (one row per junction and item, ready for the bill of quantities), Widenings (bus bays, truck parking bays and climbing lanes, section 16), Furniture quantities, Furniture checks and Basis.



Road Furniture – Demonstration road

Demonstration road · DEMO-ROAD · Junction islands and markings (RDM/1/3/2/01-02, RDM 6.1)

Road Furniture Designer · RDM 6.2 (2025) catalogue

Islands and markings placed from the standard drawings RDM/1/3/2/01-02 as templates and fitted by the designer; kerb lines, control radii and entry widths come from the junction design. Areas are painted areas (line length x line width).

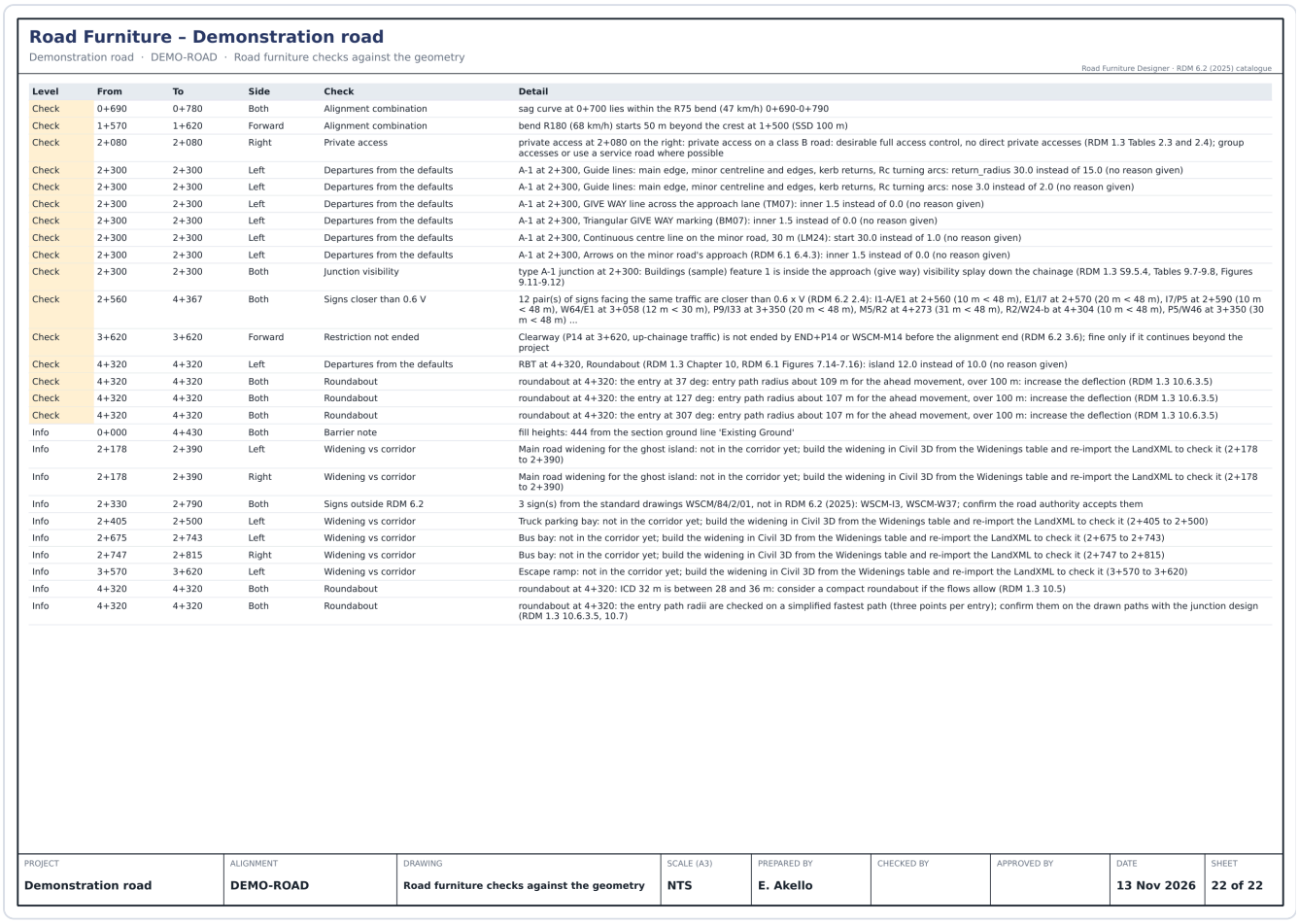
Chainage	Type	Minor road	Angle	Scale	Islands	Kerb (m)	Island area (m²)	Markings: length (m) / area (m²)	Status
2+080.0	ACCESS	Right	90°	1	-	0.0	0.0	-	approved
2+300.0	A-1	Left	80°	1	corner island, ghost island, splitter a1	51.7	55.6	AM03 0 / 2.8, AM06 0 / 2.2, BM07 9 / 1.7, HM04 12 / 1.8, HM07 143 / 21.4, HM14 278 / 41.7, LM24 30 / 3.0, LM27 35 / 5.3, TM07 2 / 1.0	approved
2+420.0	TRUCK	Left	90°	1	-	0.0	0.0	LM05 47 / 9.4	approved
2+700.0	BUS	Left	90°	1	-	68.9	25.0	BUSPLAT 86 / 0.0, LM05 34 / 6.8, SHELTER 16 / 0.0, WM-BUSSTOP 18 / 3.5	approved
2+790.0	BUS	Right	90°	1	-	69.3	25.2	BUSPLAT 86 / 0.0, LM05 34 / 6.8, SHELTER 16 / 0.0, WM-BUSSTOP 18 / 3.5	approved
3+290.0	SIG	Left	90°	1	-	0.0	0.0	AM07 0 / 6.0, BM02 0 / 42.0, LM24 120 / 12.0, TM01 14 / 5.6	approved
3+620.0	RAMP	Left	90°	1	-	0.0	0.0	-	approved
4+320.0	RBT	Left	90°	1	-	347.5	176.7	BM07 26 / 5.2, HM07 18 / 2.6, HM14 93 / 14.0, LM24 36 / 3.6, TM04 14 / 2.8, TM07 12 / 4.9	approved

PROJECT	ALIGNMENT	DRAWING	SCALE (A3)	PREPARED BY	CHECKED BY	APPROVED BY	DATE	SHEET
Demonstration road	DEMO-ROAD	Junction islands and markings (RDM/1/3/2/01-02, RDM 6.1)	NTS	E. Akello			13 Nov 2026	20 of 22

Figure 27. Junction islands and markings schedule.

19 Furniture checks

When the report is made, RFD works the following out again from the geometry with the project's settings and compares it with what is in the project. Each check is an Issue, a Check or Info, for the designer to resolve or accept.



Road Furniture – Demonstration road

Demonstration road · DEMO-ROAD · Road furniture checks against the geometry

Road Furniture Designer · RDM 6.2 (2025) catalogue

Level	From	To	Side	Check	Detail
Check	0+690	0+780	Both	Alignment combination	sag curve at 0+700 lies within the R75 bend (47 km/h) 0+690-0+790
Check	1+570	1+620	Forward	Alignment combination	bend R180 (68 km/h) starts 50 m beyond the crest at 1+500 (SSD 100 m)
Check	2+080	2+080	Right	Private access	private access at 2+080 on the right: private access on a class B road: desirable full access control, no direct private accesses (RDM 1.3 Tables 2.3 and 2.4); group accesses or use a service road where possible
Check	2+300	2+300	Left	Departures from the defaults	A-1 at 2+300, Guide lines: main edge, minor centreline and edges, kerb returns, Rc turning arcs: return_radius 30.0 instead of 15.0 (no reason given)
Check	2+300	2+300	Left	Departures from the defaults	A-1 at 2+300, Guide lines: main edge, minor centreline and edges, kerb returns, Rc turning arcs: nose 3.0 instead of 2.0 (no reason given)
Check	2+300	2+300	Left	Departures from the defaults	A-1 at 2+300, GIVE WAY line across the approach lane (TM07): inner 1.5 instead of 0.0 (no reason given)
Check	2+300	2+300	Left	Departures from the defaults	A-1 at 2+300, Triangular GIVE WAY marking (BM07): inner 1.5 instead of 0.0 (no reason given)
Check	2+300	2+300	Left	Departures from the defaults	A-1 at 2+300, Continuous centre line on the minor road, 30 m (LM24): start 30.0 instead of 1.0 (no reason given)
Check	2+300	2+300	Left	Departures from the defaults	A-1 at 2+300, Arrows on the minor road's approach (RDM 6.1 6.4.3): inner 1.5 instead of 0.0 (no reason given)
Check	2+300	2+300	Both	Junction visibility	type A-1 junction at 2+300: Buildings (sample) feature 1 is inside the approach (give way) visibility splay down the chainage (RDM 1.3 S9.5.4, Tables 9.7-9.8, Figures 9.11-9.12)
Check	2+560	4+367	Both	Signs closer than 0.6 V	12 pair(s) of signs facing the same traffic are closer than 0.6 x V (RDM 6.2 2.4): I1-A/E1 at 2+560 (10 m < 48 m), E1/I7 at 2+570 (20 m < 48 m), I7/P5 at 2+590 (10 m < 48 m), W64/E1 at 3+058 (12 m < 30 m), P9/I33 at 3+350 (20 m < 48 m), M5/R2 at 4+273 (31 m < 48 m), R2/W24-b at 4+304 (10 m < 48 m), P5/W46 at 3+350 (30 m < 48 m) …
Check	3+620	3+620	Forward	Restriction not ended	Clearway (P14 at 3+620, up-chainage traffic) is not ended by END+P14 or WSCM-M14 before the alignment end (RDM 6.2 3.6); fine only if it continues beyond the project
Check	4+320	4+320	Left	Departures from the defaults	RBT at 4+320, Roundabout (RDM 1.3 Chapter 10, RDM 6.1 Figures 7.14-7.16): island 12.0 instead of 10.0 (no reason given)
Check	4+320	4+320	Both	Roundabout	roundabout at 4+320: the entry at 37 deg: entry path radius about 109 m for the ahead movement, over 100 m: increase the deflection (RDM 1.3 10.6.3.5)
Check	4+320	4+320	Both	Roundabout	roundabout at 4+320: the entry at 127 deg: entry path radius about 107 m for the ahead movement, over 100 m: increase the deflection (RDM 1.3 10.6.3.5)
Check	4+320	4+320	Both	Roundabout	roundabout at 4+320: the entry at 307 deg: entry path radius about 107 m for the ahead movement, over 100 m: increase the deflection (RDM 1.3 10.6.3.5)
Info	0+000	4+430	Both	Barrier note	fill heights: 444 from the section ground line 'Existing Ground'
Info	2+178	2+390	Left	Widening vs corridor	Main road widening for the ghost island: not in the corridor yet; build the widening in Civil 3D from the Widenings table and re-import the LandXML to check it (2+178 to 2+390)
Info	2+178	2+390	Right	Widening vs corridor	Main road widening for the ghost island: not in the corridor yet; build the widening in Civil 3D from the Widenings table and re-import the LandXML to check it (2+178 to 2+390)
Info	2+330	2+790	Both	Signs outside RDM 6.2	3 sign(s) from the standard drawings WSCM/84/2/01, not in RDM 6.2 (2025): WSCM-I3, WSCM-W37; confirm the road authority accepts them
Info	2+405	2+500	Left	Widening vs corridor	Truck parking bay: not in the corridor yet; build the widening in Civil 3D from the Widenings table and re-import the LandXML to check it (2+405 to 2+500)
Info	2+675	2+743	Left	Widening vs corridor	Bus bay: not in the corridor yet; build the widening in Civil 3D from the Widenings table and re-import the LandXML to check it (2+675 to 2+743)
Info	2+747	2+815	Right	Widening vs corridor	Bus bay: not in the corridor yet; build the widening in Civil 3D from the Widenings table and re-import the LandXML to check it (2+747 to 2+815)
Info	3+570	3+620	Left	Widening vs corridor	Escape ramp: not in the corridor yet; build the widening in Civil 3D from the Widenings table and re-import the LandXML to check it (3+570 to 3+620)
Info	4+320	4+320	Both	Roundabout	roundabout at 4+320: ICD 32 m is between 28 and 36 m: consider a compact roundabout if the flows allow (RDM 1.3 10.5)
Info	4+320	4+320	Both	Roundabout	roundabout at 4+320: the entry path radii are checked on a simplified fastest path (three points per entry); confirm them on the drawn paths with the junction design (RDM 1.3 10.6.3.5, 10.7)

PROJECT	ALIGNMENT	DRAWING	SCALE (A3)	PREPARED BY	CHECKED BY	APPROVED BY	DATE	SHEET
Demonstration road	DEMO-ROAD	Road furniture checks against the geometry	NTS	E. Akello			13 Nov 2026	22 of 22

Figure 28. Furniture checks for the demonstration road: two alignment combinations for the designer to look at, and the source of the fill heights.

Check	What is compared
Centre line	Every no-overtaking zone has a centre line that prohibits overtaking for that direction. The passing sight distance governs.
Barriers	Every span the fill warrant asks for, with its run-out, is covered. Barriers without a fill warrant are listed (fine for obstacles and structures RFD does not check); discretionary fills, clear-zone and verge notes.
Signs	Signs the geometry asks for are in the project; signs facing the same traffic are 0.6 V apart (chevron series and plates excepted); proposals not yet accepted.
Start and end of restrictions	Every sign that opens a restriction is closed further on for the same traffic, and plates go with their signs: P32 → P32 + END (with a W23 at the start); P5–P8 → P9 or the next limit; P14 → P14 + END; the supplementary WSCM-M14 (End of All Prohibitions) also ends speed limits, no-overtaking zones and clearways, and WSCM-M9 is ended by WSCM-M8 or M14; P17 → P18; P30 → P31; W27 → W28; IM12/IM13 → IM4/IM26; W21/W22 with a W23; road works RW40 → RW40 + RW41, RW38 → RW39, RW30–RW34 → RW35. Applies to signs placed by hand as well as RFD's own. The pairs are in `rfd/data/sign_pairs.json` ; add rules in `RFD_SIGN_PAIRS_PATH` .

Check	What is compared
Alignment combinations	A sag inside a bend that limits the speed; a warned bend within the stopping sight distance beyond a crest.
Features and speed limits	Calming features and crossings visible from the SSD; a speed limit above the design speed.
Junctions	Each placed junction's crossing angle against RDM 1.3 §9.2.3: a check under 75° (preferably 75–120°, a smaller skew to be justified), an issue under the absolute minimum of 60°. Visibility splays: the profile and the obstruction layers (section 16).
Control at the road's end	Where our road starts or ends on another alignment of the LandXML, a junction (our road as the minor road, or a roundabout) or an R1 / R2 facing the traffic towards that end within 60 m; otherwise a check.
Roundabouts, accesses, bays and lanes	The roundabout sizes and arms (RDM 1.3 Chapter 10), private accesses (§9.11.16, Tables 2.3–2.4), bus and truck bay spacing and length, the entry of each bay seen from the stopping sight distance (§13.2), and the widenings against the re-imported corridor (section 16).
Descents	An escape ramp on a curve, narrower than 3.6 m or wider than 12 m, or with a bed shorter than Eq 12.1 needs (RDM 1.3 §12.7); a ramp site with no ramp within 500 m.
Departures	Every junction, bay, lane or ramp dimension changed from the RDM drawing in the Properties table, with its reason (Info); a Check where no reason was given.
Signs outside RDM 6.2	Info listing the supplementary WSCM signs used, for the road authority to accept.

20 DXF for Civil 3D drawings

Export to Civil 3D (DXF) asks for the DXF file and the plan scale (default 1:2500). The placement package (`*_placement.json`) for the parked Dynamo route is written beside it.

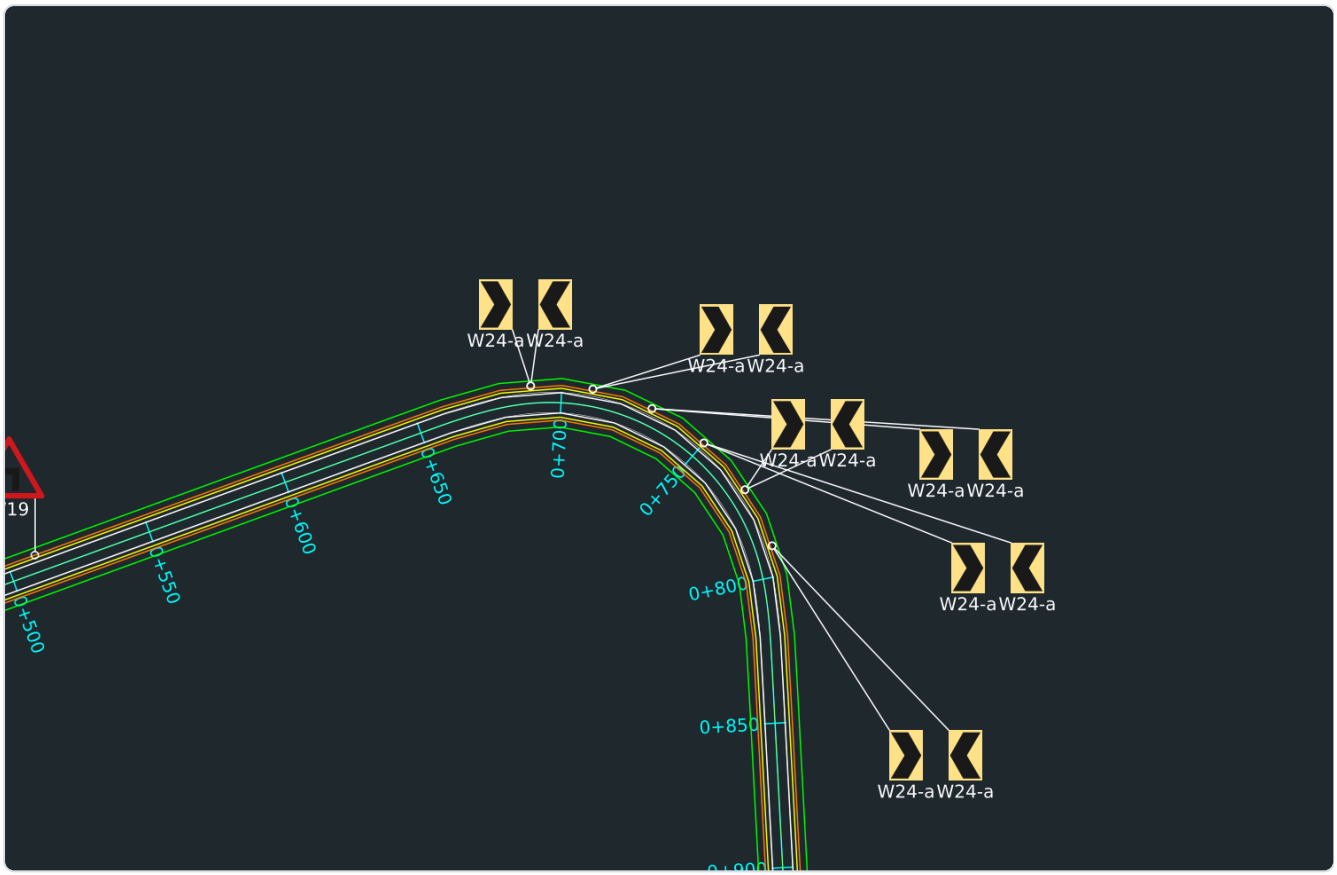


Figure 29. The exported DXF at the sharp curve, 1:2500: each sign a block at its post with a leader to the upright face; markings at their painted width; chainages; corridor edges and the alignment on non-plotting reference layers.

- **Size.** Symbols print at 10 mm: 25 m in model space at 1:2500, 10 m at 1:1000. Codes, legends and chainages print at 1.8 mm.
- **One block per sign, at the post.** Each sign is a block `RSDC_<code>_<id>` inserted at the post's true coordinates, holding a post marker, a leader, the face upright and the code. Directional signs and plates get their own block with the real legend.
- **Attributes and identity.** Every sign block carries `SIGN_CODE`, `LEGEND`, `DESCRIPTION`, `SIZE`, `CHAINAGE`, `OFFSET`, `SIDE`, `FACING`, `POST_REF`, `FACE_UUID` and `INSTALL_UUID`, with the UUIDs repeated in XDATA (application `RSD`).
- **Linear furniture** on `RSD-MARK-*`, `RSD-STUD-*` and `RSD-BARRIER-*` layers in world coordinates; broken lines use metre linetypes and markings are drawn at their painted width.
- **Reference geometry** (non-plotting): the alignment with chainages, every other alignment in the LandXML, the corridor edges by code, and a coordinate check point.

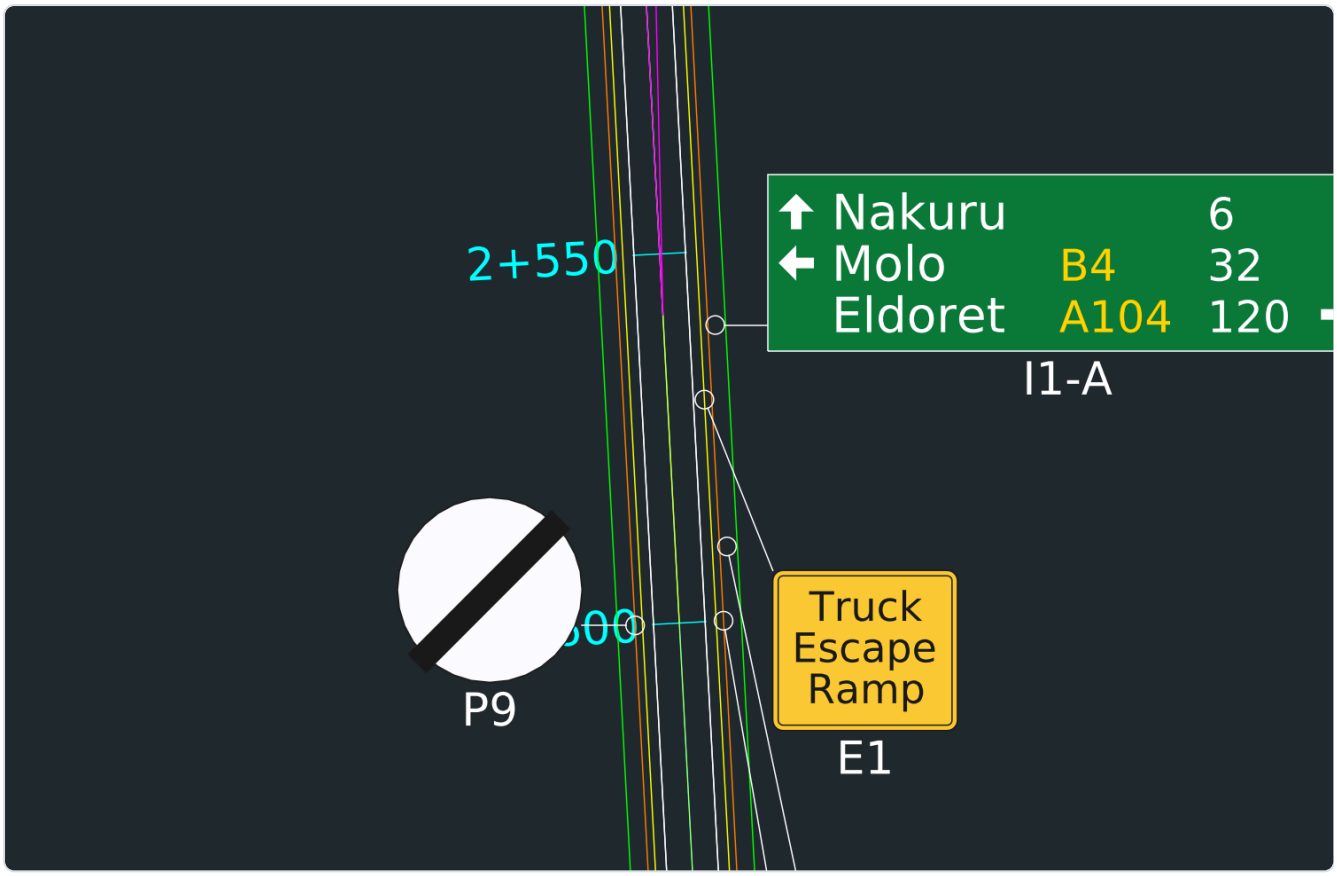


Figure 30. A directional sign and a place-name sign in the DXF, with their legends as real text.

21 Copy and paste at the true coordinates

The DXF is in the LandXML's own world coordinates: easting and northing in metres, with no local origin, shift, scale or rotation. The header records metres as the unit and custom variables `RSD_CRS`, `RSD_MAP_ZONE`, `RSD_SOURCE_LANDXML`, `RSD_ALIGNMENT` and `RSD_COORDINATES`.

1. Open `*_placement.dxf` in Civil 3D.
2. Select what to copy, for example `QSELECT` → Layer = `RSD-SIGN`.
3. `COPYBASE` with base point `0,0,0`.
4. In the project drawing, run **`PASTEORIG`**. Everything lands at its true coordinates.

Alternatively, `INSERT` or `XREF` the whole DXF at `0,0,0`, scale 1, rotation 0. The project drawing must be in metres, use the same coordinate system and be in the World UCS.

> **CHECK POINT**
> The layer `RSD-REF-NOTES` holds a cross at the start of the alignment labelled with its easting and northing. Paste it once to confirm it falls on the Civil 3D alignment, then delete it.

Dynamo scripts that place native blocks and read moves back are kept in `dynamo/`, but that route is parked; use the DXF.

PART 5

Technical manual

How the data is stored, what is read from the LandXML, the geometry and design formulas, the catalogue, the plan-layout method, and how the outputs were verified.

22 Data model

Table	Contents
rsd_signs	Point per sign face. User fields and derived fields (Appendix A).
rsd_lines	Linear runs: item, chainages, side, offset and edge, width and flip, status, rule and reason; geometry, length and quantities derived.
rsd_meta	Key/value: LandXML path (relative), alignment, project name, schema, CRS, criteria set, Prepared / Checked / Approved by.
rsd_alignment, rsd_chainage, rsd_edges, rsd_vcurves	Alignment, chainage ticks, corridor edges, vertical curves.

Faces on one post share an `install_uuid`; each face has its own `face_uuid`; each run its `line_uuid`. The UUIDs follow an item through the inventory, the package, the DXF and any read-back. Everything a rule, a feature or a speed zone creates carries its `rule` (`curve`, `marking`, `barrier`, `feature:<id>`, `speed:<id>` ...), so it can be listed, replaced or removed as a group. On-disk names keep the `rsd_` / `RSD` prefix of earlier versions so existing projects and drawings keep working.

23 What is read from the LandXML

Element	Used for
CoordinateSystem	EPSG code and name: layer CRS, DXF header.
Alignment / CoordGeom	Line, Curve and clothoid Spiral elements; coordinates northing first, as Civil 3D writes them.
StaEquation	Displayed chainage versus internal station.
Feature SpeedStation, Roadway/DesignSpeed	Design speed by chainage.
Superelevation / FullSuperelev	e for curve speeds.

Element	Used for
Profile / ProfAlign, ProfSurf	Design profile; existing ground on the long sections.
CrossSects	Coded points (ETW, EPS, Hinge, Ditch, Daylight) become road edges and barrier sections; the section ground line is the original ground for barriers.
Surfaces	Skipped when loading; read only to sample original ground under sections that lack a ground line.

The file is streamed (`iterparse`) and corridor sections are read by a byte scan, so large exports load quickly: a 59 MB project export opens in about 0.6 s.

24 Geometry methods

- **Point at station and offset.** Closed form for lines and arcs, numerical integration of curvature for clothoids. Positive offsets are to the right of increasing chainage.
- **Station and offset of a point.** The alignment is densified, the nearest segment found through a grid index, and the result refined on the element.
- **Road edges.** Section offsets are interpolated along the road per code and side; an edge is absent across a gap longer than three times its usual section spacing (at least 30 m).
- **Corridor clamp.** The post is held 0.6–3.0 m beyond the reference edge; the outer corridor limit applies only where the verge is modelled.
- **Sight distance.** A running scan of the profile (and, if set, a sight line inside bends) gives the farthest visible point from each station in each direction.

25 Design criteria and formulas

Item	Method	Source
Curve safe speed	$V^2 = 127\ R\ (e + f_{max}(V))$, solved by iteration	RDM 1.3 Table 5.1
Advance distance	6 s of travel at the design speed, rounded up to 10 m	RDM 6.2 §2.4
Spacing; lateral position	0.6 V metres; 0.6–3.0 m beyond the edge	RDM 6.2 §2.4
Chevron spacing	By radius	RDM 6.2 Table 4.2
Steep grades	Descent > 5 %, ascent > 10 %	RDM 6.2 §4.6.4
Stopping and passing sight distance	Eye 1.05 m; object 0.20 m (SSD), 1.3 m (reduced PSD)	RDM 1.3 Tables 3.13, 3.16, 3.20
Crest and sag K	Headlight sight distance in sags (0.6 m, 1° up-spread)	RDM 1.3 Tables 6.1, 6.4
Marking dimensions; stud intervals	Mark, gap and width by speed class; 6 / 9 / 12 m	RDM 6.1 Tables 4.1–4.3, 13.2
Barrier warrant, run-out, set-back, clear zone	Figure 12.4 curves (digitised); Table 12.6; §12.6.6; Table 12.1	RDM 1.3 Chapter 12

Item	Method	Source
Humps, tables, bumps, bar markings	Tables 2.1–2.3, Figure 2.4, §2.4.2	RDM 6.4
Speed limit signs	Start, middle and end of the section; P9 at the end	RDM 6.2 §3.5
Sign sizes	By design speed for Stop, Give Way, warning and circular regulatory signs	RDM 6.2 Tables 3.1, 3.3, 4.1

CRITERIA FILES

The values above live in criteria files (`rfd/data/criteria`): `kenya_rdm_2025` (default) and `aashto_2011` . Other manuals or project values can be added as files with an `extends` parent, through `RFD_CRITERIA_PATH` or the Auto tab's **Add...**; see `docs/criteria/README.md` . The report's Basis sheet cites the tables used.

26 The sign catalogue



Figure 31. A selection of the 251 RDM 6.2 signs in the catalogue, drawn from the manual's own figures.

- **Source.** `tools/extract_rdm_signs.py` reads RDM 6.2 (2025), matches each figure caption to its framed artwork, keeps the sign and drops dimension lines, and writes an SVG icon and a CAD block per sign (`RSD_<code>`). `tools/build_catalogue.py` adds sizes, legend types and size rules.
- **Coverage.** R, M, P, W, I, E, PD, IM and RW signs. Signs used both ways round have a mirrored version (`_M`); W24 chevrons are split into W24-a to W24-d.
- **END plate.** RDM 6.2 ends a no-overtaking zone (§3.11) and a clearway (§3.6) with the same sign and a supplementary plate reading END, but gives the plate no code. RFD calls it `END` ; its artwork is the identical plate of Figure 10.43 (RW41).
- **Numbering clashes in the manual**: Fig 7.1 captioned P1 becomes PD1; County Boundary becomes I10B; the expressway symbol becomes IM4S; directional examples become I20-D, I21-D, I22-D.
- **Not in the catalogue.** Design drawings without artwork (I1-C, I2-b, I5-a, IM7, IM14, IM15, IM20, IM28). RDM 6.2 has no pedestrian-crossing information sign and no bus-stop sign (the WSCM bus stop sign is in

the supplementary group below).

- **Coding.** RFD uses RDM 6.2 codes on drawings and schedules. The Ministry's standard drawings WSCM/84/2/01 (2024) number signs differently (WSCM W1 is Sharp Left Turn; RDM W1 is Crossroads).

Supplementary signs from the standard drawings

Nineteen signs on the standard drawings WSCM/84/2/01 (Jan 2024) have no RDM 6.2 equivalent. They are in the catalogue group **Supplementary (WSCM)**, always with a `WSCM-` prefix so they can never be read as an RDM code: WSCM W22 is River Bed Crossing, while RDM W22 is a series of bends. `tools/extract_wscm_signs.py` extracts their artwork from the two sheets. The River Bed Crossing sign is given the red border of the other warning signs (the sheet hatches its border black, a drafting slip). `rfd/data/wscm_crossref.json` maps all 75 WSCM codes to RDM 6.2 (same, similar or none). Every schedule shows the WSCM code, and the furniture checks list the WSCM signs used.



Figure 32. The 19 supplementary signs from WSCM/84/2/01.

27 Plan layout of symbols and sheets

At drawing scale a sign symbol is far bigger than its post (25 m at 1:2500), so drawings show it beside the road with a leader. The same method places symbols in the DXF and on the plan sheets:

1. Faces are grouped by post. Faces with the same facing stack top to bottom (sign over plate); back-to-back faces sit side by side.
2. Groups are taken in chainage order. Each is tried just outside its post, away from the road, then slid along the road and only then moved further out, until its box clears every box already placed.

3. The leader runs from the post to the nearest point of the group's box.

Plan sheets are cut so the road fits: the window is shortened by 10 % at a time until the road, turned to run along the sheet, fits the viewport with room for symbols either side.

28 Verification

Check	Data	Result
Automated tests	Synthetic roads	301 core tests, including 60 random roads through signs and markings, 40 with random embankments, 30 with random calming features, 30 with random speed zones and 30 through the report checks, junction templates square and skewed on both sides, and the packaged plugin ZIP; 43 headless QGIS tests, including the dock fitting a 380 px panel.
Whole workflow	Nine alignments from private Civil 3D exports (names withheld)	Signs, markings, barriers, features, speed zones, report (up to 97 pages for a 36 km road in about 2 s), inventory and DXF, with no failures; RFD's own proposals pass its furniture checks.
Alignment geometry	Private exports with up to 26 spirals	Element ends reproduce the LandXML coordinates.
DXF georeferencing	Private export; automated test	The reference alignment starts exactly at the LandXML's first point; every sign back-computes to its chainage and offset with no measurable difference; sign blocks are inserted at their posts.
Paste into a project drawing	Civil 3D project drawing	COPYBASE 0,0 and PASTEORIG: signs and plates landed on the alignment at their chainages.
Barrier heights	Private export with section ground lines and a TIN	Heights from the section ground lines and from the TIN agree to the millimetre.

29 Limitations and roadmap

- **Markings**: breaks through junctions, splayed and hatched double lines on sharp bends (RDM 6.1 Figure 4.6) and lane lines on multi-lane roads are not proposed yet; draw them by hand.
- **Barriers**: roadside obstacles (RDM 1.3 Table 12.4), median barriers, terminal flares and bridge parapets are not proposed.
- **Roundabouts**: drawn from the island, ICD, radii and arms you give; the entry path radius is checked on a simplified fastest path (three-point construction smoothed through the island), not the full set of paths; multi-lane entries, mini and signalised roundabouts are not designed.
- **Not yet**: dual carriageways; advance direction and direction signs (RDM Table A1-1).
- **Junctions**: islands and markings are templates to place and fit; junction geometry and kerb lines are not designed. Signing covers the Junction Ahead warnings on our road and the R2 Give Way on our approach where our road is the minor road. Visibility splays are checked in plan against the layers you tick and on the main road's profile, not in 3D (a bank or hedge must be in a layer). Turn arrows go where the template puts them; move them to the lanes of the junction design.
- **Descents**: the runaway-truck speeds are a simple energy model (40 km/h at the top, 1 % rolling resistance, no braking); escape ramps are laid out in plan, their vertical design and the arrester bed's

grading are done in Civil 3D.

- **Bus bays, truck parking bays, climbing and descending lanes, brake check areas and escape ramps** are placed where the designer clicks (lanes, brake check areas and ramps can be proposed from the profile); the widening itself is built in the Civil 3D corridor from the Widenings table and checked against it after the LandXML comes back. Rest areas are not drawn.
- **Civil 3D**: the DXF paste works; the Dynamo link is parked. Block names, layers and annotation style can be matched to an office standard later.
- **Quantities**: post and foundation types are generic and project-defined.

30 Troubleshooting

Symptom	Cause and fix
Export says to fix errors first	A check is at error level (for example a post inside the travelled way). Fix it on the Inventory tab's list.
No road edges, no edge lines or no barriers proposed	The LandXML has no coded corridor sections. Export them from Civil 3D, or give a carriageway width on the Linear tab for edge lines.
Barrier heights look too small or too large	Check which ground was used (the reason says): without a section ground line or TIN the daylight point is used. Choose the ground surface on the Linear tab.
Signs pasted in the wrong place	The project drawing is in another coordinate system, in millimetres, or in a user UCS. Check the check point against the alignment.
Every sign sized for 80 km/h, or no curve warnings where expected	No design speeds or superelevation in the LandXML. Define them in Civil 3D and export again.
No grade, no-overtaking or centre-line proposals	The design profile is not attached to the alignment in the export.
"Restriction not ended" in the checks	A sign such as P32 or a speed limit is not closed before the alignment end. Fine if it continues beyond the project; otherwise add the end sign.
Could not write the file	The workbook or drawing is open in Excel or CAD, or the folder is read-only. Close the file, or choose another folder.
`ModuleNotFoundError: No module named 'Road-Furniture-Designer-…'` on install	The ZIP is the source repository (GitHub's Code → Download ZIP, or a release's Source code link). Install the plugin ZIP from a release's Assets or the Actions artifact (section 3).
Visibility splays drawn for 80 km/h	The main road's alignment has no design speeds (or it is a clicked direction). Type its speed as Main road speed on the Junctions + bays tab and place the junction again.
No obstructions found, though there are buildings	Only the ticked layers are checked, and only features inside the splays count. Make sure the layer is ticked and in a coordinate system QGIS can transform.
"Not in the corridor yet" although the bay is built in Civil 3D	The widening is not on the ETW code (it moved another code, such as the shoulder), or the corridor has no section inside the bay. Model the widening on the ETW and sample sections through the bay, then export again.

Symptom	Cause and fix
Access returns start at the ETW, not the shoulder	The corridor has no shoulder edge code (EPS, EOS, ESH or Shoulder). Export the corridor with it, or accept the ETW.
No climbing lane proposed on a long climb	The grade between PVIs is within its Table 6.6 length, the AADT given is under 2,000 pcu, or the profile is not in the export. Place the lane by hand if you need one.
"Main road alignment … is not in the LandXML"	A minor-road junction refers to an alignment that is no longer in the export. Re-export it with our road, or remove the junction and place it again with a clicked direction.
The dock is gone	Press the toolbar button: it shows the dock and brings it to the front if it is tabbed behind another panel. A floating dock that went off screen comes back docked.

Appendix A · Fields and layers

Sign layer fields (rsd_signs)

Field	Kind	Meaning
face_uuid, install_uuid	identity	Face and post identities, kept across all exchanges.
post_ref	user	Post number (P001…).
sign_code, size, size_auto, mirror	user	RDM code, size (mm or custom), Auto size, mirrored version.
facing, facing_auto, skew	user	Forward / Backward, Auto facing, skew in degrees.
legend, road_class	user	Legend text and colour scheme.
post_type, foundation, remarks	user	For the QTO.
status, rule, reason	engine	`proposed`, `approved` (accepted proposal) or empty for hand-placed; the rule and the reason.
chainage, chainage_m, station_int	derived	Displayed chainage (text and metres) and internal station.
offset_m, side, face_az	derived	Offset from the centreline, L/R, face azimuth.
edge_ref, edge_clear	derived	Reference edge and clearance beyond it.
grade_pct, speed_kmh	derived	Design grade and speed at the sign.
description, face_svg, stack	derived	Sign name, generated face file, position in the post's stack.

Linear layer fields (rsd_lines)

Field	Kind	Meaning
line_uuid	identity	Run identity, kept across exchanges.
item_code, sta_from, sta_to, side, offset_m, edge_ref	user	Item, internal chainages, L / C / R, offset and the edge it is measured from.
width_m, flip, no_overtaking	user	Width across the road (transverse items); combined line binding the other direction; stud interval.
status, rule, reason, remarks	engine / user	As for signs.
description, category, colour, pattern, unit	derived	From the catalogue; pattern at the design speed of the run.
ch_from, ch_to, length_m, quantity, speed_kmh	derived	Displayed chainages, length, quantity (m, number or m²) and design speed.

Junction layer fields (rsd_junctions)

Field	Kind	Meaning
piece_uuid, junction_id	identity	The piece (its features share it) and the junction it belongs to.
kit, piece, corner, code, params	template	Junction type, template piece, corner (left_turn / other), marking code (KERB, GUIDE, HM07 ...) and the kit's settings for the piece.
sta, bearing_deg, scale, edge_m	user	Junction point (internal chainage), minor road direction, scale, main-road edge offset (blank: ETW or 3.5 m). Editing one rebuilds the piece.
role, main_ref, our_sta	placement	`main`, `minor` (our road joins another) or `bay`; the main road (`alg:<name>` or a clicked line); our road's chainage at the junction.
status, rule, remarks	engine / user	Rule `junction:<id>`.
kind, description, ch, side, crossing_deg	derived	Island, marking or guide; displayed chainage; minor road side; crossing angle.
kerb_m, island_m2, line_m, paint_m2	derived	Kerb length and island area (on the kerb feature); painted line length and area (length × line width).
rbt	derived	Roundabouts: island, arms, quantities, the arms' details for the signs, and the checks (JSON).
access	derived	Private accesses: width, radius, distance to the boundary, road class, quantities and checks (JSON).
sight	derived	Visibility splays: main road speed used (and whether assumed), set-backs, lengths and the profile sight distance for each splay (JSON).
widen_m2, bay	derived	Bus bays, truck parking bays and climbing lanes: widened area, and the bay's stations, side, tapers and width (JSON) for the Widenings table.

DXF layers

Layer	Plots	Contents
RSD-SIGN, RSD-SIGN-TEXT, RSD-SIGN-LEADER	yes	Sign blocks, attribute text, post markers and leaders.
RSD-MARK-*, RSD-STUD-*, RSD-BARRIER-*	yes	Markings, road studs and barriers by item code.
RSD-JN-KERB, RSD-JN-<code>	yes	Junction island and bus bay kerbs (truck bay pavement edge on `RSD-JN-BAYEDGE`; private accesses on `RSD-JN-ACCESS`, `-ACCESS-P` and `-PIPE`); junction, bay and lane markings and hatching by RDM 6.1 code (bus platform `BUSPLAT`, shelter `SHELTER`).
RSD-JN-SPLAY-A, RSD-JN-SPLAY-S	yes	Visibility splays, approach and stop.
RSD-JN-GUIDE	no	Junction construction lines (freeze for the final drawing).

Layer	Plots	Contents
RSD-ALIGN, RSD-ALIGN-OTHER	no	Alignment with chainages; other alignments, named.
RSD-EDGE-<code>, RSD-REF-NOTES	no	Corridor edges by code (`RSD-EDGE-TS-<code>` for the edges of a typical section); coordinate check point.