

National Road Design using AutoCAD® Civil 3D® Software

By Leslie Faughnan

The wide remit of Kerry County Council includes a range of responsibilities for planning, amenities and services for its 140,000 permanent residents and more than 2.5 million holiday visitors annually. Kerry is a premier tourism destination and also the fifth largest county in Ireland by area. The geography of 'The Kingdom' means that it has a high proportion of national roads at 430 km together with 4,230 km of other public roads. This was recognised in 1993 with the establishment of the Kerry CC National Road Design Office as one of 11 such specialist regional offices created with the formal establishment of the National Roads Authority.



River Feale crossing at the Kerry/Limerick boarder

North Farranfore overbridge

Based in Castleisland since 1995, the Kerry National Road Design Office (NRDO) has a professional staff of 20, including project managers, design and road safety engineers, engineering technicians, an archaeologist and administrative support staff. The 432 km of national roads under their care consists of 96 km of national primary roads and 336 km of national secondary roads. The major national road projects completed in the county since 2000 have involved the improvement of over 20 km of carriageway on National Primary Routes carried out over five separate contracts involving capital expenditure of over €100 million covering design, land acquisition and construction.

A number of other major projects in the Kerry NRDO are currently at various stages of design, including the N22 Tralee Bypass comprising an 8 km Type 2 and 5.7 km of single carriageway linking the planned bypass to a recently improved section of the N22 Killarney to Cork road. The construction of this scheme is a stated objective of the National Development Plan, Transport 21 and the National Spatial Strategy as well as the NRA Road Needs Study, Tralee LUTS Report, Kerry County Development Plan and Tralee Town Development Plan.

The N22 Tralee Bypass will remove over a quarter of all traffic from Tralee town centre and is expected to cater for up to 18,500 vehicles per day by 2026, including 9,300 of national through traffic. The N22 Tralee Access Route will remove about half of the traffic from the recently improved N21 Ballycarty to Tralee road and so ensure that both roads operate at the target Level of Service D (80 kph average inter-urban speed) for new national road schemes in their respective design years.

"This is a 15-year traffic projection based on the project getting under way in 2011," explains Donal O'Connell, Assistant Engineer in the Kerry NRDO. "When our initial design phase is completed it will be followed by land CPO's (Compulsory Purchase Orders) and then the tender process for the design and build contract."

The project design is being carried out on AutoCAD Civil 3D, which was introduced in 2005 as the principal road design software in Kerry NRDO. Civil 3D replaced the previous combination of AutoCAD Land Desktop with the DOER (Department of the Environment Roads) software which is DOS-based. AutoCAD Civil 3D is complemented by Autoturn, developed by Autodesk partner Transoft Solutions, a specialised program to simulate vehicle manoeuvres for aspects of project design such as access, turning circles and clearances.

Kerry NRDO has been using Autodesk design software since it was set up and it was this familiarity which led to the decision to evaluate, try and then adopt AutoCAD Civil 3D as the basis for all new designs since 2005. "The principal benefit, and it has proved enormous for us, was the transition to dynamic 3D modelling," says Donal O'Connell. "Our design output has increased significantly in many respects. Take the deceptively simple task of altering road alignments to take account of different factors. That used to be a laborious business of tweaking the 2D plans and is now almost instantaneous, allowing engineers to make minute adjustments to the volumes of earth works, dimensions of land-take areas or clearance of structures."

The design of the road corridors is very important in road planning, since in addition to topographical or engineering factors it may be necessary to conform to or avoid land boundaries. "The ability to essentially just click and update all elements of the corridor is a huge time saver and means that more numerous finite designs can be prepared at the route selection stage of a road project." According to Donal O'Connell, this has also been aided by the ease with which Lidar (laser measurement) data and information from low level aerial surveys can be imported into the Civil 3D design files.

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AutoCAD Civil 3D minimises manual editing because it derives production drafting directly from the model, which means that after minor design changes the associated project drawings are automatically updated. This is a feature that has been of particular benefit to the drafting staff in Kerry NRDO, in ease and speed of revision but also in obviating potential mistakes. "We have found the 'Almost Dynamic' nature of junction design most useful and have been using it on the Tralee Bypass project for the design of at-grade priority junctions, grade-separated elements and roundabouts."

In a similar vein, Donal O'Connell points out that the grading tools in Civil 3D have been particularly useful in the design of flood alleviation measures. "Because the grading tools are intelligent, the land take and earthworks required for the attenuation ponds can be rationalised, especially in situations where the shapes proposed are atypical. The office has also begun using Hydraflow Storm Sewers, a specialised drainage design extension to Civil 3D which is proving valuable in coping with existing watercourses, storm channels and potential flooding issues in the vicinity of the project. The current Tralee Bypass project, in common with others, involves planning routes and road designs to deal with sensitive ecological areas and the constraints that arise. In that context, he says that Kerry NRDO particularly welcomes Autodesk's moves towards creating specialised drainage design software for Civil 3D and look forward to its full integration in future releases.

The nature of the public road projects undertaken by Kerry NRDO means that information exchange with external bodies and professionals is an ongoing requirement, from specific data file sharing with project partners and consultants to the presentation of plans and designs for public consultation. "We have found Civil 3D extremely flexible in terms of sharing data, for example in the new features that allow our users to export directly to AutoCAD in one simple step and also to export corridor feature lines as 3D polylines for those not using Civil 3D."

Mapping is another area of frequent information exchange and Kerry NRDO has been using Mapinfo for GIS purposes for some years. "We have become less dependent on it with the improved Map 3D functionality of Civil 3D," Donal O'Connell says. "Our users can edit many GIS formats directly (including .SHP) and we can also import other formats such as TAB files for editing within Civil 3D. This has been beneficial in many respects and reduced our reliance on standalone GIS packages. We can work with users of Mapinfo and ArcInfo and also import Ordnance Survey and Geological Survey information directly."

The next step in the Kerry NRDO is towards higher quality visualisation of proposed plans and designs. "We are currently reviewing a number of 3D model animation solutions with a view to enhancing our Civil 3D output with the creation of virtual drive-throughs and fly-overs. There is in fact a sense in which we are not yet getting full value from our investment in AutoCAD Civil 3D and its powerful digital modelling until we can show our professional work in that modern and compelling way—which is also excellent for sheer clarity of presentation, leaving little room for misunderstanding or ambiguity. We believe this could be a very valuable tool in presenting design proposals and alternatives to various audiences, including for example public consultation where we might be looking at perhaps five different route options for a road scheme," Donal O'Connell concludes.

