RUNNING HORSE TURBO ROUNDABOUT, MAIDSTONE

POST-CONSTRUCTION SCHEME REPORT



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1. Background Information

Running Horse Roundabout, Maidstone is an arterial junction at the point where the A229 meets M20 junction 6. As well as the M20 being the official route for traffic travelling to and from the Channel ports, the A229 serves as primary link between Maidstone and the Medway Towns, as well as the crossing point between the M20 and M2 motorways. Local traffic also uses the roundabout to reach destinations on the north side of Maidstone. These factors result in an extremely busy roundabout, which suffered from a high amount of congestion and, more importantly, a poor crash record.

The junction has been subject to several improvement schemes over the years in an attempt to improve the situation. The junction has been one of the top sites in Kent that have incidents resulting in personal injury for many years, but most designs have failed to achieve any significant reduction in crashes. Therefore, it was deemed appropriate to utilise an innovative approach, building on concepts from overseas to deliver a design which aims to bring about a safer and better flowing junction for road users, as well as reducing the maintenance burden on Kent County Council (KCC).

2. The Turbo Roundabout

2.1 The Concept and Introduction by Kent County Council

The concept was first developed by Professor L Fortuijn in the Netherlands in late 1990s as a safer and more efficient alternative to standard multi-lane roundabouts. Today, there are over 300 turbo roundabouts in the Netherlands (an average of 12 installations per year), spanning a road network of approximately 139,000km. With the UK having a larger network of approximately 395,000km, this would be the equivalent of around 850 turbo roundabouts on UK roads, or 34 per year over the same period. The design has more recently been introduced in Germany, North America and Eastern Europe, bring the total number of turbo roundabouts outside the UK to around 390.

The concept of a turbo roundabout is that drivers must choose their lane before entering the junction, and are committed until they reach the appropriate exit. This is enforced through the use of a physical barrier (similar to a back-to-back chamfered kerb), known as a band. In this regard, it is similar in nature to a segregated left-turn at a traditional roundabout, with that concept applied to every lane. By eliminating the changing of lanes and reducing the number of conflict points, Dutch research suggests a 72% reduction in crashes when compared to a similar multi-lane roundabout. Furthermore, capacity is shown to increase by approximately 46%, as well as lowering vehicle speeds.

KCC Design & Delivery Principal Engineer, Chris Koningen, was keen to bring the turbo roundabout to the UK, following using this type of junction many times in Europe over a 20-year period. Having been tasked with producing a new design for Running Horse Roundabout, and having reviewed the existing crash analysis, he felt this would be an ideal opportunity to introduce the turbo roundabout. A hybrid model of a turbo and traditional multi-lane roundabout had been constructed at Flanders Roundabout (Avenue Jacques Faucheux/Bad Münstereifel Road), Ashford in 2019, and provided a basis for the new layout at Running Horse Roundabout.

2.2 UK Adaptation

As well as switching the Dutch design to work for left-side driving, it was also necessary to contemplate how drivers would react to this new junction type. Whilst using physical banding to separate lanes was considered, it was felt that the Running Horse Roundabout junction was too major a junction to use as the first location, as well as it being difficult to import the correct products from the European Union, not just for initial installation but also any future maintenance. Since completion of this project, however, it appears the products may be becoming available in the UK, so it may be possible to use those at a future site.

With physical lane banding being deemed unfeasible, it was decided to develop a concept first introduced on Flanders Roundabout, Ashford, which was first implemented in October 2019 in an attempt to enforce lane discipline. The scheme appears to have been successful in this regard, although as with any new approach, improvements were identified and taken into account during the design for Running Horse Roundabout.

The UK version of the turbo roundabout utilises a 1m wide strip of red surface treatment, edged with solid white lines and red road studs, and overlaid with white hatching. On the approaches to each section of banding, a white area of road marking is applied to draw drivers' attention to the

area where they are committed to that lane. Where drivers need to enter lane 2, the red surface continues in a band but the white markings are omitted, with the aim that road users already on the roundabout will continue to follow the red band, but drivers entering know they can cross into the inner lane. Drivers are further aired by way of dashed road markings, guiding them into the correct position.

2.3 Innovative Surveying and Imagery Using Drone Technology

Given the extremely busy nature of this junction, surveying the site during the design stage was very problematic. In the first use of its kind in Kent, a 3D surveying drone was used to produce a topographical record of the entire site, including all street furniture, signage and highway features, with an accuracy of ±6mm. This data was then used within AutoCAD© to produce the design.

A further benefit of the drone survey was that it was possible to use the same data for construction. By utilising GPS beacons, extremely accurate setting out points could be plotted on site, saving time whilst also reducing the possibility of errors.

Following construction, an imaging drone was used to capture both video footage and still images to provide a record of the work undertaken both during and after construction, as well as seeing how the junction was used in the first days following completion. Some of those images have been used in this report.

The use of drones was an integral part of the scheme, providing both accurate and time-efficient solutions. More importantly, by enabling surveying work to take place remotely and without the need for working in the carriageway and/or traffic management, activities could be undertaken more safely and at a far lower financial cost.

3. Non-standard Features

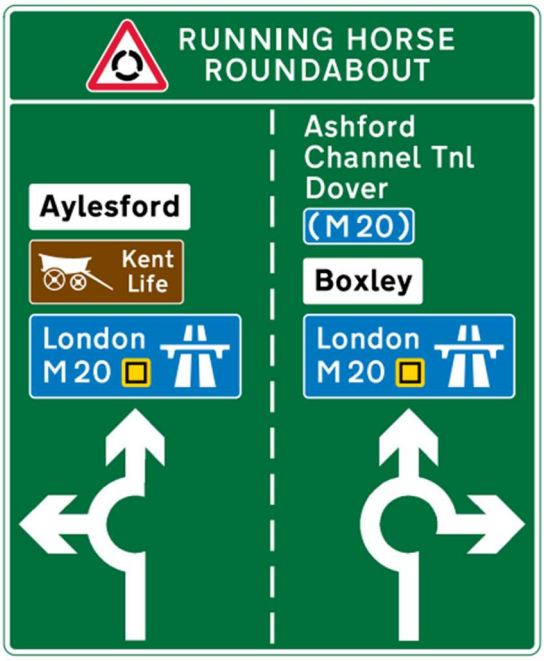
3.1 Introduction

As with any road design, it is key that drivers are able to use the junction intuitively and without undue distraction. After careful consideration, it was felt that existing UK road marking and signing standards did not accommodate the needs of a turbo roundabout. Therefore, the Dutch Rijkswaterstaat (Ministry of Infrastructure and Water Management) was approached for details of their own design standards. These were utilised to produce a version that would be familiar to UK drivers by way of using elements of symbols they would be used to, such as but not limited to arrowhead size and shape.

The full palette of non-standard signs and road markings is shown below.

3.2 Lane Discipline Sign Symbols and Destinations

3.2.1 Example Drawing



3.2.2 Commentary

The symbols to be used are based on those used successfully on the approach to turbo roundabouts in The Netherlands, adapted to match standard UK arrowheads as much as possible, aiding drivers in recognising their meaning. These have been used as it is felt to better inform road users of which exits can be reached from each lane, particularly when multiple exits can be reached from the same lane.

A decision has also been taken to include destinations that can be reached by either lane on both lanes depicted on the sign. This is because it is felt that the standard approach of having the destination written above a sold bar, covering all lanes, is unclear to drivers. The design being used here aims to address that issue.

Finally, the standard roundabout warning triangle sign has been included in the name panel. This is to further alert drivers to the junction type ahead.

3.3 'Stay in Lane' Sign

3.3.1 Example Drawing

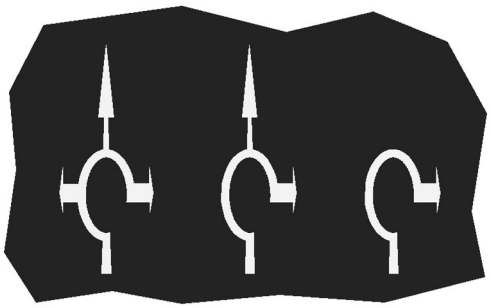


3.3.2 Commentary

The key to a turbo roundabout being successful is ensuring drivers do not change lanes once they enter the system. As this junction type has only been used once in the UK before (Flanders Roundabout), it is felt that additional signage is required to alert drivers to this fact. There is no appropriate sign available that tells drivers not to change lanes, and therefore one has been created using elements taken from the 'no overtaking sign', and including a red diagonal bar to make it clear this is a prohibited movement. By taking inspiration from the TSRGD 2016, it is felt that drivers should understand the meaning, despite not having seen the sign before. The text and yellow backing board are designed to alert drivers to the restriction, as well as explain the symbol.

3.4 Destination Lane Arrows

3.4.1 Example Drawing



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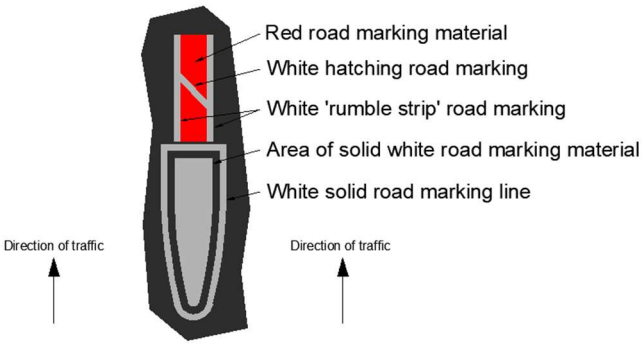
3.5 Destination Lane Arrows

3.5.1 Example Drawings



3.5.2 Commentary

These markings imitate the physical concrete ‘banding’ used on the Dutch turbo roundabout design. The white lines are laid on top of an area of red thermoplastic, which is intended to warn drivers that this is an area they may not cross. Rumble strips have been used on either side of the red area to give road users an audible warning should they stray across the lines. The area of white ‘tear drop’ provides a strong visual warning to drivers that this is the start of the system. Red road studs will be placed at 1m centres along both sides of the marking from entry to exit, mimicking the studs that are cast into the concrete units used in The Netherlands.

On the approach to the system there is a 16m set of ‘no overtaking’ markings dividing the lanes. This includes 8m of green road studs, followed by 8m of amber studs (at 1m centres), giving drivers a visual alert of the turbo roundabout layout they are about to enter.

4. Early Contractor Involvement

4.1 Introduction

Whilst having dialogue with contractors is extremely important with any project, the nature of this scheme including the complexities of design, construction, traffic management and road space availability meant that good planning was vital. Chris Koningen (KCC) worked extremely closely with his contractor counterpart, Chris Court (Amey), to cover all aspects of the work in order to ensure construction went as smoothly as possible.

A key element of this relationship was openness and honesty on all sides. There will always be unforeseen issues with a project of this nature, and the direct approach taken by all parties meant that these could be overcome quickly and with minimal disruption. In this regard, credit must be given to all who worked on the scheme for their professionalism, flexibility and transparency.

4.2 Road Space and Traffic Management

4.2.1 Road Closures and Diversions

Running Horse Roundabout had never been fully closed before, to be the best knowledge of KCC. Given the complexity of the scheme and how traffic management would need to regularly change, it was agreed that a full shutdown of the junction would be employed. KCC utilised the one.network platform to plan all closure points and diversions, with five different diversion routes being required.

Given the proximity of the junction to the M20 and numerous strategic diversions, it was felt that utilising different symbols would be confusing for drivers. Therefore, each route was assigned a different number, with road users directed to a different number depending on their destination. This appeared to be successful, with KCC not receiving any negative feedback from drivers. As such, the diversion plans are being held and will be utilised for any future closures of the roundabout.



4.2.2 Workforce Safety (Intellicone© by Highway Resource Solutions)

It was suggested by Amey that a new system that alerts of illegal closure incursion be trialled, given the high chance of drivers trying to avoid following the diversion routes. Whilst all entry points were manually monitored, there was still a significant risk that road users may speed through the closures, posing a hazard to the health and safety of operatives, as well as themselves.

Highway Resource Solutions provided their Intellicone© product, which triggers an audible alarm across the works site if the closure point is breached. On the first night of construction, this provided an invaluable warning to operatives when somebody illegally drove through the closure and into the site, giving staff time to move out of the carriageway. The value of this system to health and safety cannot be underestimated and has subsequently been employed at another KCC construction site.



4.2.3 Sign Installation (New Approach Contractors)

The large size of the signs required at this junction meant that substantial concrete foundations were required, with time to cure before mounting lattix posts and sign panels. The need to ensure the roundabout could be opened and used safely during the day meant that we would need to leave the previous signs in situ for the duration of construction, and therefore, the foundations were placed behind the existing units.

Unknown underground services were identified at one of the locations, with their location meaning a redesign was required at pace. KCC worked with New Approach Contractors (NAC) on site to produce a solution that could safely be built, whilst meeting the strength needs of the sign itself.

Unfortunately, during delivery one of the advanced directional signs was damaged, with a replacement not being available before erection was needed. NAC and Amey provided an innovative temporary solution to ensure drivers would not be confused by the new layout, which proved to be successful. This consisted of utilising the existing signage in conjunction with the undamaged part of the new plates, producing a hybrid sign that, whilst unusual, meant the road could open with sufficient messaging for drivers.

Whilst on site, it became apparent that there was an existing sign that was not included in the design, and would need to be changed. Mistakes such as this will happen, and KCC, Amey and NAC worked together to find a solution quickly, and implemented at pace. This joint working and flexibility is key to a successful outcome, which both Amey and NAC demonstrated to great effect.



4.2.4 Resurfacing (C W Surfacing)

The largest element of the scheme in terms of operation size and planning was the resurfacing of all approaches, as well as the circulatory carriageway itself. The width of the roundabout meant there would have been three joints running longitudinally, leading to points that have a high risk of failure in future years. C W Resurfacing (CWS) carried out the surfacing inlay in two phases, meaning there would be only a single join beneath the red banding, where drivers should not cross. In order to avoid other joins, two pavers ran around the roundabout side-by-side, effectively providing a double-width paved area. This is an example of how using amended working practices can provide a longer-lasting product, at no additional cost.

CWS demonstrated extreme pride in their work, and consequently produced an excellent result.





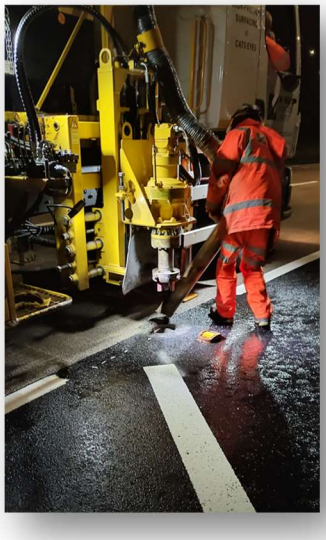
4.2.5 Surface Treatment, Lining and Road Studs (Hi-Way Services)

In terms of successful utilisation of the roundabout by the travelling public, the surface treatments, lining and road studs were of paramount importance. All the work undertaken needed to be clear, concise and accurate to the design.

Hi-Way Services (HS) were instrumental in advising on the products that would bring about the most long-lasting finish, reducing the maintenance liability and providing a clear layout for road users. During the design period, HS advised on their recommendations, resulting in PumaTrack© by Hitex being used for the red areas, and AR100 for the white lining. This is a great example of using contractor expertise to inform the design, illustrating the importance of having detailed and open conversations prior to construction.

HS also installed Marker Series 290 road studs by 3M, in an embedded 301 inset casing. These were relatively new to KCC, and were recommended by both Amey and HS due to their higher reflectivity, whilst still being mounted into the carriageway, giving them a longer lifespan than surface-mounted units. These have been extremely effective, providing drivers with a clear guide both on approach to and around the roundabout.

The work undertaken by HS is of excellent quality, and is testament to their workmanship abilities and experience.







5. Post-Construction

5.1 Construction Reflection

The quality of work undertaken by all contractors is outstanding, both in terms of planning and construction. The entire team worked together with a positive and joined-up approach to deliver a fantastic end result of which all should be very proud. The success of this project demonstrates the importance of good planning, communication and open, honest dialogue, so that we can produce excellent schemes that benefit the travelling public.

5.2 Public Response

Such an innovative scheme in a location as busy as Running Horse Roundabout was likely to attract a great deal of attention. Whilst we always hoped it would be well-received, the number of public enquiries has been very low, demonstrating that drivers are generally satisfied with the result. It is too early to determine how impactful the design will be and the long-term view of road users, but the initial response appears to be very positive.

Two weeks after completion, a local news outlet ran a poll to gauge public reaction to the new layout. Of those who had used the roundabout since completion, 69% said the scheme was an improvement on the old design. This was seen as a good result, particularly as we would usually expect the reception to be rather muted following construction of any scheme as drivers become used to the new layout, especially one as unusual as Running Horse Roundabout.

5.3 Industry Response

KCC has been approached by several external organisations to ask for further information on Running Horse Roundabout, with a view to replicating it elsewhere, including outside of Kent. This is extremely welcome, and shows how we can bring about change on the road network by being brave, innovative and learning from other highway authorities around the world.

Subject to the success of Running Horse Roundabout in terms of achieving its objectives, KCC hope that this will become a much more familiar sight around the UK, with the Department for Transport embracing both the design and associated signs, markings and road studs as part of national standards.

6. Principal Designer Comments

I could not be more proud of the work at Running Horse Roundabout. To see the scheme come alive after so many years of using turbo roundabouts in the Netherlands has been the pinnacle of my career, and I am incredibly grateful to all those who worked on the project with me. I believe we have demonstrated what we can achieve by pushing the boundaries (with careful consideration!), working together and learning from others.

As engineers, we are here to deliver improvements for the betterment of the travelling public. Being brave and allowing innovation such as this is testament to what our industry can do with the right mindset, as well as the crucial support of a great team.

7. Programme Manager Comments

Both the design and review of the scheme concept and the physical construction offered a number of opportunities for learning and experience for various officers throughout KCC and our partners. Logistically trying to carry out works at such a busy and well used junction created a number of challenges, from both handling and installing the traffic management to phasing of the construction works. Throughout the whole process the Project Manager and all partners welcomed and encouraged other officers and engineers to shadow the design team and visit the site throughout construction.

The application of the turbo roundabout concept has encouraged other team members within KCC to consider innovative materials and ideas which will have an ongoing positive impact on highway improvements and road safety in Kent.



Chris Koningen at Running Horse Roundabout

	Name	Date
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