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Roundabout "Auf Arzil" in Tyrol - Description of the Roundabout and Documentation of the Road Condition

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***Abstract*—** *The first roundabouts as traffic engineering facilities were not built until the beginning of the 20th century, although there were islands in the middle of the streets and marketplaces long before that time. People have always enjoyed statues and water fountains in public spaces, even in ancient Rome. Long ago, there were also traffic islands in England that served as pedestrian oases, and there were also imposing buildings in the heart of market squares in France. However, it was only the "planning border" of all these objects that turned them into traffic roundabouts. The circular roadways at roundabouts are exposed to special traffic loads due to cornering, namely friction and shear stresses, and in smaller roundabouts (mini roundabouts) also torsional stresses (turning of tyres on the spot). Especially due to the high proportion of heavy traffic, damage to the asphalt pavement is often found, such as cracks, unevenness (indentations, ruts), etc.*

***Keywords*—** *Asphalt, bitumen, circular lane, circular roadway, crack, damage, pavement, roundabout, ruts, torsional stress, unevenness.*

I. INTRODUCTION

Description of the roundabout

The traffic situation in the Imst district "Auf Arzil" was the subject of much discussion in the municipal council. Every day, numerous children cross the unclear road on their way to school. After numerous discussions, it was decided to build a roundabout with pedestrian and bicycle paths underneath [1]. The important traffic junction between the B 171 Tiroler Strasse as an east-west connection and the B 189 Mieminger Strasse as an arterial road in the direction of the Fernpass in the southern area of the town of Imst was constructed generously as a traffic-free junction in accordance with the requirements of traffic safety and traffic flow.

Due to the increased construction activity in the area of the junction in recent years, especially as a result of the rapidly growing settlement in the Imst district of "Auf Arzil", the municipality of Imst demanded that a corresponding access road be constructed via the provincial road network. At the same time, the road was to be made easier to cross for pedestrians and cyclists by means of subways, as in the past it was precisely these road users who had often chosen the shortest route via the busy road to the town centre at great risk.

The Imst roundabout on Arzil was built as a six-arm, 2-lane roundabout at the intersection of two provincial roads B 171 /B 189 in Tyrol. With an outer diameter of around 80 m, it is the largest roundabout in the whole of Tyrol [3].

TABLE 1. The relevant roundabouts data [3]

ADT* (2013)	-
ADT* (2020) [1]	17,402 Motor vehicle/24 h
Outer diameter *D*	80.0 m
Curve radius *R*	80.0/2 – 10.5/2 = 34.75 m
Circular lane width B_K	10,5 m
max. cross gradient q_{max}	2.5 %
Skid resistance value μ [2]	0.27
Asphalt surface layer	SMA11 70/100, S2, G1, 3.0 cm
Asphalt binder layer	AC22 binder PmB 45/80-65, H1, G4, 7.0 cm
Asphalt base layer	AC32 binder PmB 45/80-65, H1, G4, 8.0 cm
Upper unbound TS	Unbound base layers OTS + UTS, 60.0 cm
Lower unbound TS	Unbound base layers OTS + UTS, 60.0 cm
Opening	2013
Special feature	2-lane roundabout

*ADT - Average daily traffic [vehicle/day]

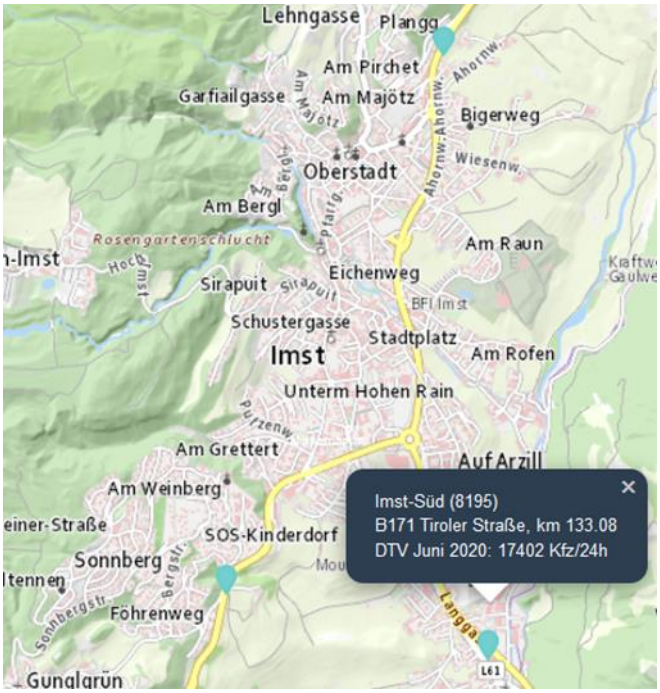

Figure 1. Annual average daily traffic JDTV, measured at point 8195 on the B 171 Tiroler Strasse [4]

The aerial view of this roundabout during construction can be seen in Fig.2, finished roundabout in Fig.3, standard cross-section in Fig.4 and site plan in Fig.5.

[1] The annual average daily traffic volume JDTVi of vehicle category *i* in the whole cross-section (in both directions) was calculated from (Land of Tyrol, 2020) [4] is adopted.

[2] Although the SMA11 asphalt wearing course with conventional bitumen B 70/100 was used for this KV (no PmB bitumen), the skid resistance value of SMA11 with polymer-modified bitumen is adopted for simplicity μ = 0.27.

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Figure 2. Aerial view of the Imst roundabout on Arzil during construction [5]

Figure 3. Finished roundabout Imst on Arzil [5]

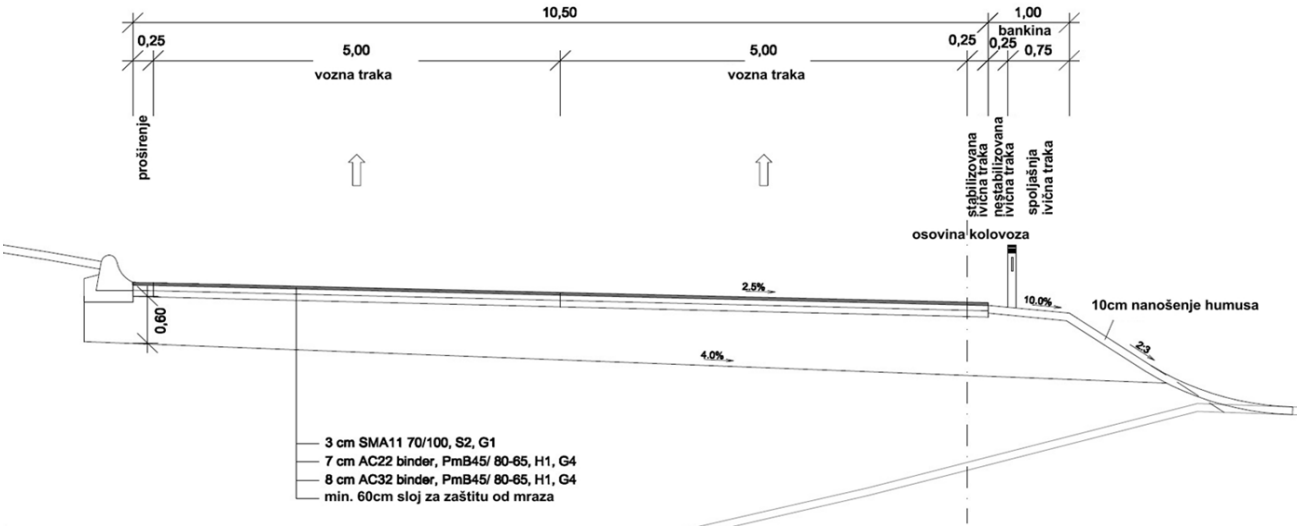

Figure 4. Standard cross-section of the Imst auf Arzil roundabout at the B 171/ B189 intersection in Tyrol [5]

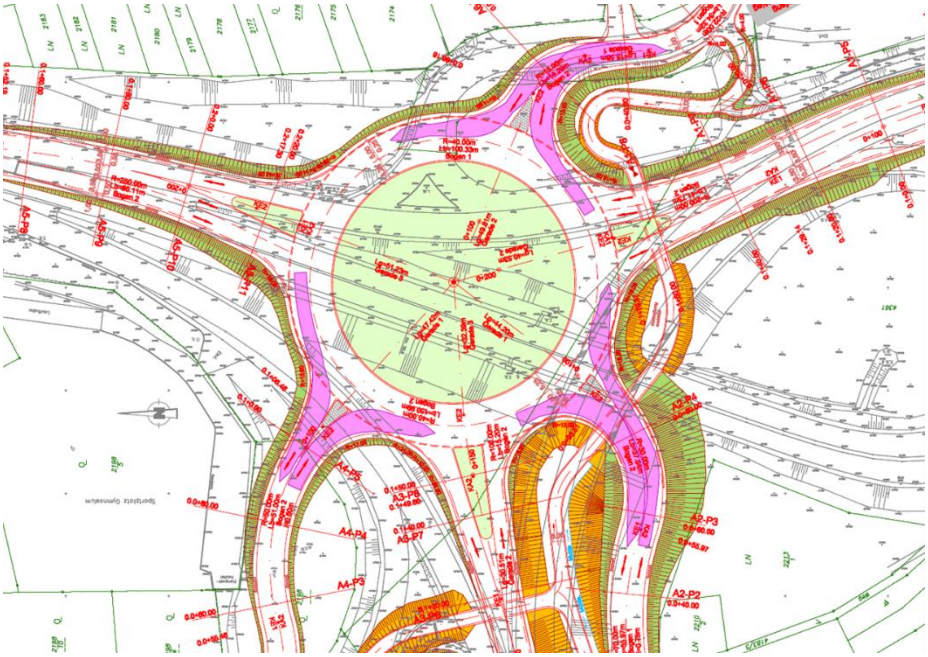

Figure 5. Site plan including tractrix curves of the Imst auf Arzil roundabout at the B 171/ B189 intersection in Tyrol [5]

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Description of the condition of the roundabout Auf Arzil

The following photos were kindly sent to me by Mr. Michael Strigl, the head of the road maintenance department Haiming in Tyrol, and I am very grateful to him. On the basis of these photos, taken on 02.11.2020, as well as information given by Mr. Strigl by telephone, there are no visible asphalt damages in the roundabout pavement of this roundabout.

Figure 6. View towards the entrance and exit of the B189 Reutte/Garmisch (GER) [6]
Figure 7. View in the direction of the B171 Innsbruck entrance and exit [6]

Figure 8. View towards the Hoch/Imst-Centre entrance and exit [6]
Figure 9. View towards the Hoch/Imst-Centre entrance and exit [6]

Figure 10. Roundabout pavement with the view towards the entrance and exit of the B171 Landeck/Mils [6]
Figure 11. Roundabout pavement with a view towards the Hoch/Imst-Centre entrance and exit [6]

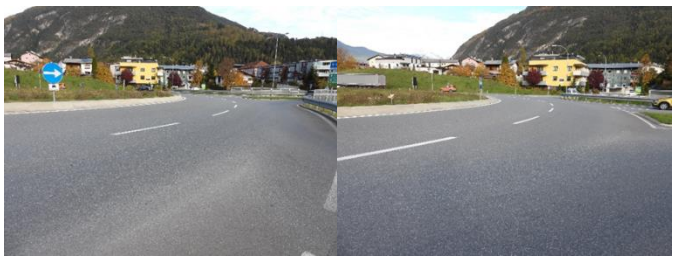

Figure 12. View in the direction of the B171 Innsbruck entrance and exit [6]
Figure 13. View towards the entrance and exit of the B171 Innsbruck [6]

Figure 14. View in the direction of the Imst entrance and exit to Arzil [6]
Figure 15. View towards the exit B189 Reutte/Garmisch (GER) [6]

II. CONCLUSION

The surface course of this roundabout is Stone Mastic Asphalt SMA11 70/100, S2, G1, 3.0 cm and this looks very good seven years after the opening of this roundabout. The above mix designation is:

SMA11 – Stone mastic asphalt with maximum grain size 11 mm. Stone mastic asphalt (SMA) is an asphalt mix with a precipitation particle size and bitumen as a binding agent, which is built up from a framework of coarse gravel aggregates with a mastic mortar.

70/100 – Road bitumen, penetration of the bitumen at +25 °C is between 70 and 100 $x10^{-1}$ mm according to EN 1426 [7].

S2 – A distinction is made between three particle size distribution classes (S1, S2 and S3), each with a maximum particle size of 8 mm or 11 mm. Simplified, it can be said: SMA S1 has a coarser grading curve, SMA S2 has a finer grading curve and SMA S3 is noise-reducing. The permissible grading curves for the grading classes S1, S2 and S3 are listed in Table 5 according to Austrian Standard OENORM B 3584 [8]. Stone mastic asphalt - Rules for the implementation of ÖNORM EN 13108-5 [9]. The categories for the void content shall be declared by the manufacturer in accordance with Table 8 and Table 9 from [8], whereby the difference for the declared values of Vmin and Vmax for S1 and S2 shall not exceed 2.0 % absolute and for S3 not exceed 4.0 % absolute.

In the case of noise-reducing Stone Mastic Asphalt, deviating from ÖNORM B 3584-1 (SMA deck S3) and RVS 08.16.01 [10], a void content of 9 to 14 % by volume and GK 8 according to RVS 04.02.11 [11] must be present in the surface course when using the basic or characteristic values.

G1 - Aggregate class of the asphalt mix according to Austrian standard OENORM B 3580-1 [12].

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