B333 - COLD IN-PLACE RECYCLING - OPSS.PROV 333

333.1 GENERAL

The Cold In-place Recycling (CIR) process involves partial depth milling of the existing asphalt pavement, sizing, mixing with emulsified asphalt and water (if required), relaying and compacting the recycled cold bituminous mixture in-place in one single operation.

CIR can rehabilitate pavement exhibiting age, thermal, fatigue and reflective cracking. CIR should be considered for roads that are severely cracked but structurally sound. It is not limited to pavements exhibiting surficial distresses. The existing pavement thickness should be at least 100 mm.

CIR helps to retard reflection cracking and localized roughness.

CIR is not suitable for pavements with extensive base or subbase problems, or structurally deficient pavements, i.e. lack of structural capacity, severe distortions and/or instability rutting.

CIR processing should avoid reaching to pavement layers that contain asbestos, geogrid, glasgrid, or layers with rich asphalt content, high recovered penetration, or fine mixes such as HL-2.

CIR process is more appropriate for roads with low to moderate traffic volumes (AADT < 15,000/2 lanes).

CIR must be placed in warm, dry weather and therefore is limited to the summer months for construction, and all CIR treatment should be completed prior to September 1st. CIR treatment cannot be carried out when the temperature is below 10 °C or the overnight forecast is less than 2 °C.

Pavements that have the following maintenance treatments may be considered since they have no detrimental effects on the CIR mix design.
- cold mix patching
- spray patching
- chip seal

The benefits of CIR mix are:
- The mix is flexible with high air voids, so reflection cracking is notably reduced
- 100 % of the material is reclaimed
- Traffic is allowed back on within one hour of its placement
333.2 REFERENCES

CDED Section B206-3, Excavation for Pavement Widening
CDED Section B308, Tack Coat
CDED Section B313, Hot Mix Asphalt
CDED Section B510, Removal

333.3 TENDER ITEMS

Cold In-Place Recycled Mix

333.4 SPECIFICATIONS

Details of the work are contained in OPSS 333.

333.5 SPECIAL PROVISIONS

Refer to Chapter E of this manual to review the applicable standard special provisions.

333.6 STANDARD DRAWINGS - none

333.7 DESIGN

333.7.1 Geotechnical Design Considerations

The CIR mix is susceptible to moisture intrusion and abrasion. It requires that a separate wearing surface such as hot mix overlay, surface treatment, or micro-surfacing be placed to seal the CIR mix. The wearing surface must be placed during the same construction season. To date, surface treatment or micro-surfacing has not been used as the separate wearing surface.

CIR treatment depths typically range from 75 mm to 125 mm. For projects with variation in existing asphalt pavement thicknesses, different treatment depths should be considered by clustering the pavement into segments of similar asphalt pavement thickness. The depth of CIR treatment shall be selected to avoid disturbance of the underlying granular base (so called ‘breaking through’). The treatment depth shall be selected to avoid ‘breaking through’ during CIR processing that could lead to potential claims and performance issues. In no case shall the remaining residual asphalt be less than 25 mm. When the residual asphalt requirement cannot be met, a different rehabilitation strategy should be considered.
A typical recycling train is installed with milling drum(s) of up to 3.8 m in width and paver with extending screed of up to 4.25 m in width. Typically, CIR process extends to the existing pavement edge (edge of lane) only. It is not recommended to process the pavement beyond the pavement edge as it will incorporate shoulder granular into the CIR mix.

After processing, CIR mix will be fluffed up 10 to 15% of the original volume of pavement due to an increase in air voids. As a result, 10 to 15% raise in grade is expected if the width of CIR mat does not change. If grade raise restriction applies on the geometric design of pavement, the CIR mix can be spread out to avoid the grade raise, resulting in increase in mat’s width.

Pavement widening using CIR is not recommended. However when it is required, the Excavation for Pavement Widening standard item may be used to prepare the shoulder area. Refer to CDED B206-3 for documentation requirements. An asphalt base should be considered along the widening strip if the thickness difference between the existing asphalt pavement and the widening pavement is large. It is not recommended to incorporate shoulder granular into CIR mix for the purpose of pavement widening.

A tack coat is required prior to Hot Mix Asphalt (HMA) paving over all areas of CIR. Use the tender item ‘Tack Coat’. The Tack Coat rate of application for cold in-place recycled surfaces is specified in OPSS 308. Reference is made to CDED Section B308, Tack Coat, for administration of this tender item.

All crack sealants must be removed prior to CIR processing, as part of the item. Estimation of crack sealant quantity to be removed should be included in Pavement Design Report.

In urban areas, the designer should be aware of appurtenance and adjustment requirements, curb heights, and accessibility concerns to accommodate the CIR equipment train and the requirement for traffic detours. At intersections, the main lanes and turn lanes of significant length (greater than 300 m) should be CIR. Different treatments (i.e., remove and replace with acceptable binder course HMA) may be applied to shorter turn tapers, irregularly shaped pavement areas, entrances, etc.

CIR should be considered for daylight operations only due to traffic control and safety concerns.

The designer should be aware that the length of the CIR paving operation may affect traffic management. A typical CIR train may extend up to 80m long. A one kilometer rolling closure is typical for the CIR operation.
Full depth repair zones such as frost treatment, distortion/distress and culvert replacement should be excavated and replaced in accordance with the designed subbase and base materials, then reinstated with HMA prior to CIR operation. The depth for the overlying HMA should be the processing depth of CIR plus 25mm. Alternatively, reclaimed asphalt pavement (RAP) can be considered instead of HMA. To avoid bumps and inconsistent transition of materials, CIR operation should continue through the full depth repair zone when its length is less than 50 m; otherwise, the zone will be skipped for CIR operation.

Pre-milling on the existing pavement surface should only be specified at selective locations when crack sealants are closely spaced, the pavement surface is severely oxidized, or where the longitudinal and/or transverse profile must be corrected. Pre-milling should be kept to a minimum.

A single pass of recycling train allows a minor cross-fall correction of up to 0.5% only. If a pavement section requires a cross-fall correction of larger than 0.5%, it should be adjusted using a patching or milling method prior to CIR operation instead of using the CIR recycling train.

For design purposes CIR with an overlay should be compared to the following conventional technique to address non-structural surficial distresses:

40 mm Superpave 12.5 over 100 mm CIR
Vs.
Full depth reclamation, (FDR), 40 mm Superpave 12.5 over two 50 mm lifts of Superpave 19.0

333.7.2 Pre-Engineering Investigation

General:

This section describes procedures and tests to be carried out during pre-engineering investigations on potential CIR projects.

Adequate pre-engineering must be carried out to establish existing pavement thicknesses and composition. Ground Penetrating Radar (GPR) is a useful method of providing more frequent measurement of the asphalt thickness. Additional investigation should be carried out where pavement composition changes, such as patched areas.

This information is required for the designer to determine whether the existing pavement on potential projects meets the minimum thickness requirement in addition to assisting the designer in selecting a depth of CIR.

Field investigation is required to determine the pavement condition, distress manifestations, and estimated sealant removal quantities.
Selection of Coring Locations:

1. A minimum of one core location per kilometre.

2. Cores shall be taken not less than 0.5 m from the edges of the pavement of the main lanes and in areas representative of the overall pavement condition. Core location should be random.

3. Cores should extend to the bottom of the lower hot mix lift.

4. Testing on cores should be conducted to determine extracted gradation, existing asphalt cement content and recovered penetration.

This information does not relieve the Contractor from obtaining cores to complete a CIR mix design.

A mix design is recommended during the pre-engineering investigation stage to confirm the in-situ materials are suitable for CIR processing, and to determine whether active filler would be required for the mix.

When Portland cement is used as active filler, the maximum addition rate is 1%.

333.7.3 Other Design Considerations

The work requires the use of a pilot vehicle as part of the process. The regional traffic section should be consulted regarding the deletion of the pilot vehicle if work is on a freeway.

333.7.4 Information to be Provided to Bidders

The existing pavement depth must be included in the documents in the form of soils borings, pavement cores, or ground penetrating radar graphs, along with the results of the pre-engineering core testing.

333.8 COMPUTATION

333.8.1 Source of Information

All requirements of a project with respect to hot mix, CIR depths, asphalt core analysis and test results including treatment of shoulders are stated in the Pavement Design Report.
333.8.2 Method of Calculation

Cold In-Place Recycling Mix is a Plan Quantity Payment item.

The unit of measurement for CIR is square metres.

The Contractor is responsible for the CIR mix design and will supply emulsified asphalt on all contracts for the CIR mix. No quantity calculations are required by the designer for this material.

The estimated bulk relative density of CIR is 2.20 t/m³.

333.9 DOCUMENTATION

It is necessary to ensure that this information is indicated for all CIR to be carried out on a project. It must include the depths of CIR and the hot mix overlays for the roadway, private and commercial entrances, side roads, tapers, interchange ramps, pavement widening, paved shoulders, partial paved shoulders, and any other miscellaneous areas to be paved.

The designer is to specify the hot mix required to be used in areas inaccessible to the CIR equipment.

The designer shall specify the following in the Contract Documents:

1. For the item Cold In-Place Recycled Mix, typical cross sections which show normal sectional requirements are to be included. Include on sections the required widths and depths of cold in-place recycling.

2. Each area quantity of CIR is shown on one row of the Miscellaneous Quantity Sheet. For each area, indicate both start and end chainage in the location and position column.

3. Sealant removal is included with the CIR tender item.

4. For areas considered by the designer to be inaccessible to the CIR equipment, hot mix is required, and is paid for under the applicable hot mix asphalt item(s). Refer to B313 for documentation requirements.

Partial depth asphalt removal and overlying HMA thicknesses shall be noted on the drawings for all areas considered inaccessible or impractical for CIR, such as private and commercial entrances, side roads, tapers, ramps, channelization, shoulders, irregularly shaped pavement areas and miscellaneous areas to be paved. Refer to CDED B510 and B313 for the design and documentation requirements for partial depth asphalt removal and HMA, respectively.
333.9.1 Documentation Accuracy

Calculated CIR quantity in square metres is recorded to the nearest whole number. Stations are recorded in whole number metres.