

I- BEBO PRECAST CONCRETE ARCH OVERFILLED SYSTEM SPECIFICATONS

1. GENERAL

1.1. DESCRIPTION OF WORK INCLUDED

THIS WORK CONSISTS OF FURNISHING AND CONSTRUCTING A PRECAST CONCRETE ARCH OVERFILLED SYSTEM IN ACCORDANCE WITH THESE SPECIFICATIONS AND IN CONFORMITY WITH THE LINES, GRADES, AND DIMENSIONS SHOWN ON THE PLANS. THE PRECAST CONCRETE ARCH SHALL BE A BEBO PRECAST CONCRETE ARCH SYSTEM.

1.2. RELATED WORK

- 1.2.1. EXCAVATION, EARTHWORK, AND CONTROLLED BACKFILL.
- 1.2.2. CAST-IN-PLACE CONCRETE FOUNDATIONS.
- 1.2.3. CAST-IN-PLACE CONCRETE LEVELING PADS IN FOOTING KEYWAY.
- 1.2.4. INSTALLATION OF PRECAST CONCRETE ARCH ELEMENTS.
- 1.2.5. GROUTING.
- 1.2.6. CAST-IN-PLACE CONCRETE CROWN JOINTS (FOR TWIN LEAF STRUCTURES ONLY).
- 1.2.7. WATERPROOFING PRECAST CONCRETE ARCH ELEMENTS.
- 1.2.8. BACKFILLING.
- 1.2.9. ROADWAY CONSTRUCTION.

1.3. RELATED DOCUMENTS

- 1.3.1. THE DESIGN SHALL BE IN CONFORMANCE WITH BS EN 1990 TO 1997 (EUROCODES) AND ADDITIONAL DOCUMENTATION AS STATED IN THE AIP.

1.4. DELIVERY, STORAGE AND HANDLING

- 1.4.1. ARCH ELEMENTS:
 - 1.4.1.1. SPREADER BEAMS MAY BE USED TO LIFT THE PRECAST CONCRETE ARCH ELEMENTS TO PRECLUDE DAMAGE FROM BENDING OR TORSION FORCES.
 - 1.4.1.2. SEE SHOP DRAWINGS FOR ELEMENT WEIGHTS AND APPROPRIATE CHAIN LENGTHS. ADJUSTMENT RACHETS TO BE USED TO ALLOW ADJUSTMENT ON SITE LENGTHS.
 - 1.4.1.3. THE CONTRACTOR MUST PROVIDE A CRANE WITH SUFFICIENT CAPACITY FOR THE INSTALLATION OF THE PRECAST ELEMENTS.
 - 1.4.1.4. CARE MUST BE EXERCISED IN HANDLING AND MOVING THE ARCH ELEMENTS. PRECAST CONCRETE ARCH ELEMENTS SHALL BE CAST LIFTED AND STORED IN UPRIGHT POSITION.
 - 1.4.1.5. PRECAST CONCRETE ARCH ELEMENTS SHOULD BE PROPERLY STORED TO PREVENT CRACKING. STORE ARCH ELEMENTS USING TIMBER SUPPORTS AS APPROPRIATE.
 - 1.4.1.6. PRECAST CONCRETE ARCH ELEMENTS MUST NOT BE SHIPPED UNTIL THE CONCRETE HAS ATTAINED THE SPECIFIED DESIGN COMPRESSIVE STRENGTH.

1.5. PROJECT SITE CONDITIONS

- 1.5.1. DO NOT PERFORM GROUTING WHEN TEMPERATURES ARE EXPECTED TO GO BELOW 5° FOR A PERIOD OF 72 HOURS.
- 1.5.2. DO NOT PERFORM BACKFILLING DURING WET OR FREEZING WEATHER.

2. EXECUTION

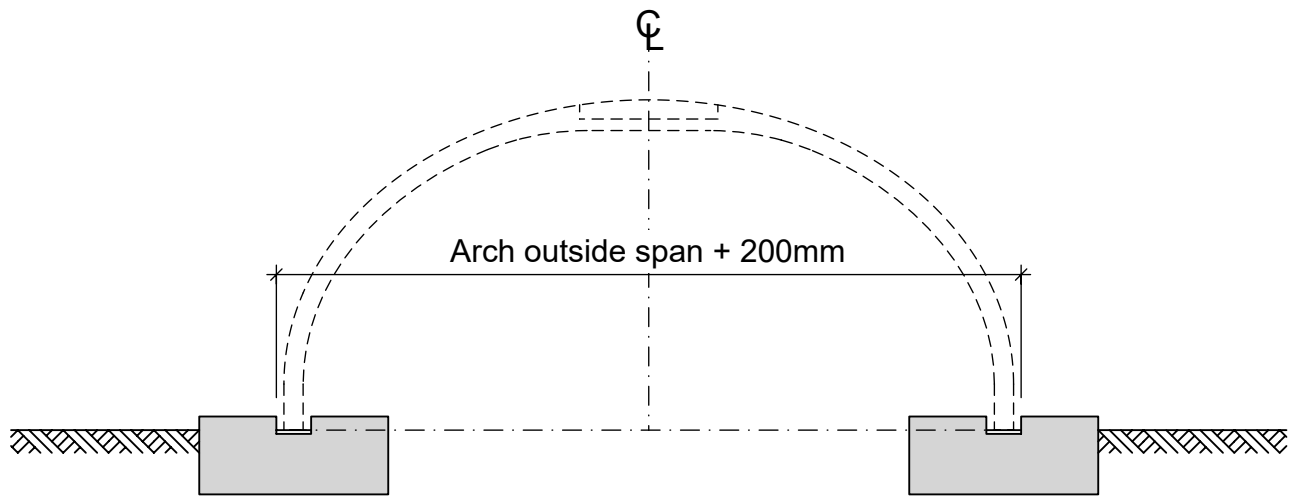
2.1. CAST-IN-PLACE (CIP) FOUNDATIONS

- 2.1.1. THE DESIGN SIZE AND ELEVATION OF THE CIP FOUNDATIONS SHALL BE AS DIRECTED BY THE SUBSTRUCTURE DESIGNER.
- 2.1.2. THE FOUNDATIONS FOR PRECAST CONCRETE ARCH ELEMENTS, SPANDREL AND WINGWALLS MUST BE CONNECTED BY REINFORCEMENT TO FORM ONE MONOLITHIC BODY. EXPANSION JOINTS SHALL NOT BE USED. SHRINKAGE AND TEMPERATURE CRACKS ARE ACCEPTABLE AND DO NOT DETRACT FROM SYSTEM PERFORMANCE AND SAFETY.
- 2.1.3. DO NOT OVER EXCAVATE FOUNDATIONS.
- 2.1.4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE ERECTION OF THE FOUNDATIONS PER THE VENDOR OF THE PRECAST CONCRETE ARCH RECOMMENDATIONS AND PER THE PLANS AND SPECIFICATIONS.
- 2.1.5. PRIOR TO INSTALLATION OF ARCH ELEMENTS, THE CONTRACTOR SHALL VERIFY THAT THE CIP ARCH FOOTINGS HAVE THE REQUIRED CONCRETE STRENGTH.

2.2. CRITICAL DIMENSIONS FOR FOUNDATIONS

- 2.2.1. TO ENSURE CORRECT INSTALLATION OF THE PRECAST CONCRETE ARCH SYSTEM ELEMENTS, CARE AND CAUTION MUST BE EXERCISED IN FORMING THE SUPPORT AREAS FOR THE ARCH ELEMENTS. EXERCISING SPECIAL CARE WILL FACILITATE THE RAPID INSTALLATION OF THE PRECAST COMPONENTS.
- 2.2.2. BEFORE STARTING ERECTION PROCEDURES, CHECK THE FOLLOWING ITEMS:
 - 2.2.2.1. DISTANCE BETWEEN TWO OPPOSITE ARCH KEY BACKS; TO BE THE ARCH OUTSIDE SPAN PLUS 200MM APPROXIMATELY OR PER THE PRECAST CONCRETE ARCH SUBMITTAL DRAWINGS.
 - 2.2.2.2. ALIGNMENT OF THE ARCH KEY ALONG THE LENGTH OF THE FOUNDATION.
 - 2.2.2.3. TOTAL LENGTH OF THE ARCH FOUNDATION IN ORDER TO CALCULATE THE EXACT SPACING NEEDED BETWEEN THE PRECAST CONCRETE ARCH ELEMENTS.

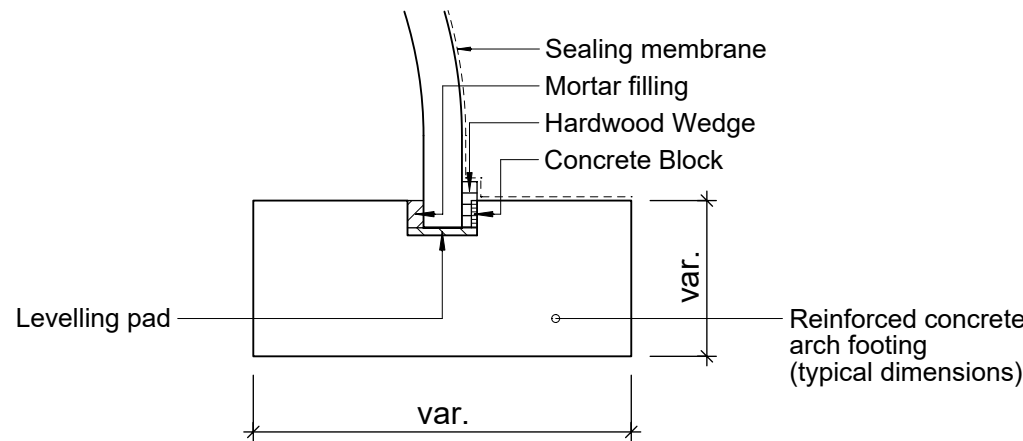
DISTANCE BETWEEN TWO OPPOSITE ARCH KEY BACKS



2.3. ARCH ELEMENT LEVELING PADS

- 2.3.1. MORTAR LEVELING PADS MUST BE POURED IN THE PREVIOUSLY CAST CONCRETE ARCH KEYS TO GUARANTEE CORRECT SEATING OF THE ARCH ELEMENTS. LEVELING PADS MUST BE APPROXIMATELY 50MM THICK AND 500MM LONG TO ENSURE THAT EACH PRECAST CONCRETE ARCH ELEMENT IS RESTING ON APPROXIMATELY 250MM OF PAD AT EACH JOINT.
- 2.3.2. THE MORTAR LEVELING PADS ARE TO BE POURED TO WITHIN 3MM OF THE REQUIRED ELEVATION.
- 2.3.3. THE GROUT SHALL BE A MINIMUM OF C35/45 WITH MAXIMUM AGGREGATE SIZE OF 6MM.
- 2.3.4. NO LOADS ARE ALLOWED ON THE MORTAR LEVELING PADS UNTIL THEY ACHIEVE A DESIGN STRENGTH OF 25MPA.

FOOTING DETAIL WITH LEVELING PADS



2.4. INSTALLATION PROCEDURES FOR THE PRECAST ELEMENTS

IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT A CRANE OF THE CORRECT LIFTING CAPACITY IS AVAILABLE TO HANDLE THE PRECAST CONCRETE UNITS. THIS CAN BE ACCOMPLISHED BY USING THE WEIGHTS GIVEN FOR THE PRECAST CONCRETE ARCH SYSTEM COMPONENTS AND BY DETERMINING THE LIFTING REACH FOR EACH CRANE UNIT. SITE CONDITIONS MUST BE CHECKED WELL IN ADVANCE OF SHIPPING TO ENSURE PROPER CRANE LOCATION AND TO AVOID ANY LIFTING RESTRICTIONS. THE LIFT ANCHORS PROVIDED IN EACH UNIT ARE THE ONLY MEANS TO BE USED TO LIFT THE ELEMENTS. THE PRECAST CONCRETE ELEMENTS MUST NOT BE SUPPORTED OR RAISED BY OTHER MEANS THAN THOSE GIVEN IN THE MANUALS AND DRAWINGS WITHOUT WRITTEN APPROVAL FROM THE DESIGNER OF THE PRECAST CONCRETE ARCH SYSTEM.

2.5. INSTALLATION OF ARCH ELEMENTS

- 2.5.1. A SUFFICIENT QUANTITY OF HARDWOOD WEDGES 100MM WIDE MUST BE AVAILABLE AND ON SITE FOR USE AS SHIMS TO PREVENT LATERAL SPREADING OF THE PRECAST CONCRETE ARCH UPON INSTALLATION. A GOOD SUPPLY OF 3, 6 AND 12MM THICK SHIMS OR CONCRETE BLOCKS FOR VARIOUS SHIMMING PURPOSES SHULD BE ON SITE. STEEL SHIMS ARE NOT PERMITTED. IF REQUIRED, SHIMMING BETWEEN U/S OF BEBO ELEMENTS AND LEVELLING PADS IS PERMISSIBLE.
- 2.5.2. MEASURE FROM THE END OF THE FOUNDATION AND MARK THE TOP OF EACH LEVELING PAD WHERE EACH ARCH IS TO BE PLACED. SPACING BETWEEN ARCH ELEMENTS IS APPROXIMATELY 10MM. CHECK THE TOTAL LENGTH OF THE FOUNDATION AGAINST THIS VALUE. IT IS HELPFUL TO HAVE 10MM SHIMS AVAILABLE TO ASSIST IN SPACING THE PRECAST CONCRETE ARCH ELEMENTS AS THEY ARE BEING SET.
- 2.5.3. A SPREADER BEAM MAY BE USED TO LIFT THE PRECAST CONCRETE ARCH ELEMENTS FROM THE TRUCK.
- 2.5.4. A SLING ASSEMBLY, WITH RIGGING MUST BE AVAILABLE TO ROTATE THE ELEMENT IN THE AIR TO THE INSTALLATION POSITION.
- 2.5.5. THE BEBO PRECAST CONCRETE ARCH ELEMENT IS THEN LOWERED INTO/ONTO THE KEY OF THE CIP CONCRETE FOUNDATIONS. IT IS IMPERATIVE THAT ANY LATERAL SPREADING OF THE ARCH ELEMENT BE AVOIDED WHILE AND AFTER IT IS INSTALLED. THE PRECAST ARCH MUST BE COMPLETELY WEDGED BETWEEN THE CIP CONCRETE FOOTINGS BEFORE THE COMPLETE RELEASE OF THE ARCH ELEMENT FROM THE CRANE.
- 2.5.6. IT IS PARTICULARLY IMPORTANT TO CHECK THE CROWN LEVEL OF TWIN LEAF E & C-SERIES' ARCHES. THE HEIGHT OF THE CROWN SHOULD BE MEASURED BY A SURVEYOR WHILE THE CRANE CABLES ARE STILL UNDER TENSION. UNDER NO CIRCUMSTANCES SHOULD THE CROWN LEVEL BE BELOW THAT OF THE SPECIFIED LEVEL GIVEN IN THE DRAWINGS. THE CROWN LEVEL MAY BE ADJUSTED BY SLIGHTLY REDUCING THE ARCH SETTING OUT SPAN.
- 2.5.7. BEBO TWIN LEAF PRECAST CONCRETE ARCH UNITS ARE TRANSPORTED AND LIFTED IN A SIMILAR MANNER AS THE SINGLE-LEAF ELEMENTS. TWO CRANES (OR ONE CRANE AND DISPLACEABLE SCAFFOLDING) ARE REQUIRED FOR THE ERECTION OF THE BEBO PRECAST ARCH UNITS.
- 2.5.8. IDEALLY, ONE CRANE SHALL BE LOCATED ON EACH (OUTER) SIDE OF THE FOUNDATIONS TO INDEPENDENTLY LIFT HALF-ARCH UNITS FROM THE DELIVERY TRUCKS AND INTO POSITION. THE TWO TWIN UNITS ARE LIFTED AND POSITIONED SIMULTANEOUSLY.
- 2.5.9. ALTERNATIVELY, IF CRANES ARE TO BE POSITIONED ON THE SAME SIDE OF THE FOUNDATIONS OR WITHIN THE ARCH SPAN, THEY SHOULD BE LOCATED SO THAT THE FINAL JOINTING MOVEMENT OF THE UNITS AT THE CROWN CAN BE EFFECTED WITHOUT DAMAGE TO THE INTERLOCKING JOINT KEY.
- 2.5.10. BEFORE RELEASING THE LOAD OF EACH BEBO ARCH HALF UNIT FROM THE CRANE, BOTH ELEMENTS MUST BE WEDGED AT THE CIP CONCRETE FOUNDATIONS IN THE CORRECT POSITION AND THE CURVED BOLT MUST BE INSERTED AND FIXED IN THE BLOCK OUTS AT THE CROWN JOINT.
- 2.5.11. ONCE CORRECTLY POSITIONED AND ALIGNED, THE BEBO TWINLEAF UNITS ARE JOINTED AT THE CROWN WITH CAST-IN-PLACE CONCRETE AS SHOWN IN THE DRAWINGS.
- 2.5.12. BEBO PRECAST CONCRETE ARCH SYSTEM TWINLEAF PROFILES ARE DESIGNED FOR THE ARCH DEAD LOAD TO ACT ON THE THREE-PINNED ARCH. IN CASE SCAFFOLDINGS ARE USED FOR THE ERECTION, THEY MUST BE REMOVED (OR LOWERED) BEFORE THE CROWN JOINT IS CAST.
- 2.5.13. CHECK THE SPAN WIDTH AT REGULAR INTERVALS TO MINIMIZE THE SPREADING.

2.6. WATERPROOFING AND SUBSOIL DRAINAGE

- 2.6.1. SUBSOIL DRAINAGE SHALL BE AS SHOWN ON THE PLANS.
- 2.6.2. WATERPROOFING SHALL BE AS STATED IN THE AIP.

2.7. GROUTING

- 2.7.1. FILL THE ARCH KEY WITH GROUT. COMPACT AS REQUIRED TO ENSURE THAT THE ENTIRE KEY AROUND THE ARCH ELEMENT IS COMPLETELY FILLED.
- 2.7.2. FILL THE FACE LIFTING ANCHOR RECESSES WITH GROUT.
- 2.7.3. THE GROUT SHALL BE A MINIMUM OF C35/45 WITH MAXIMUM AGGREGATE SIZE OF 6MM.

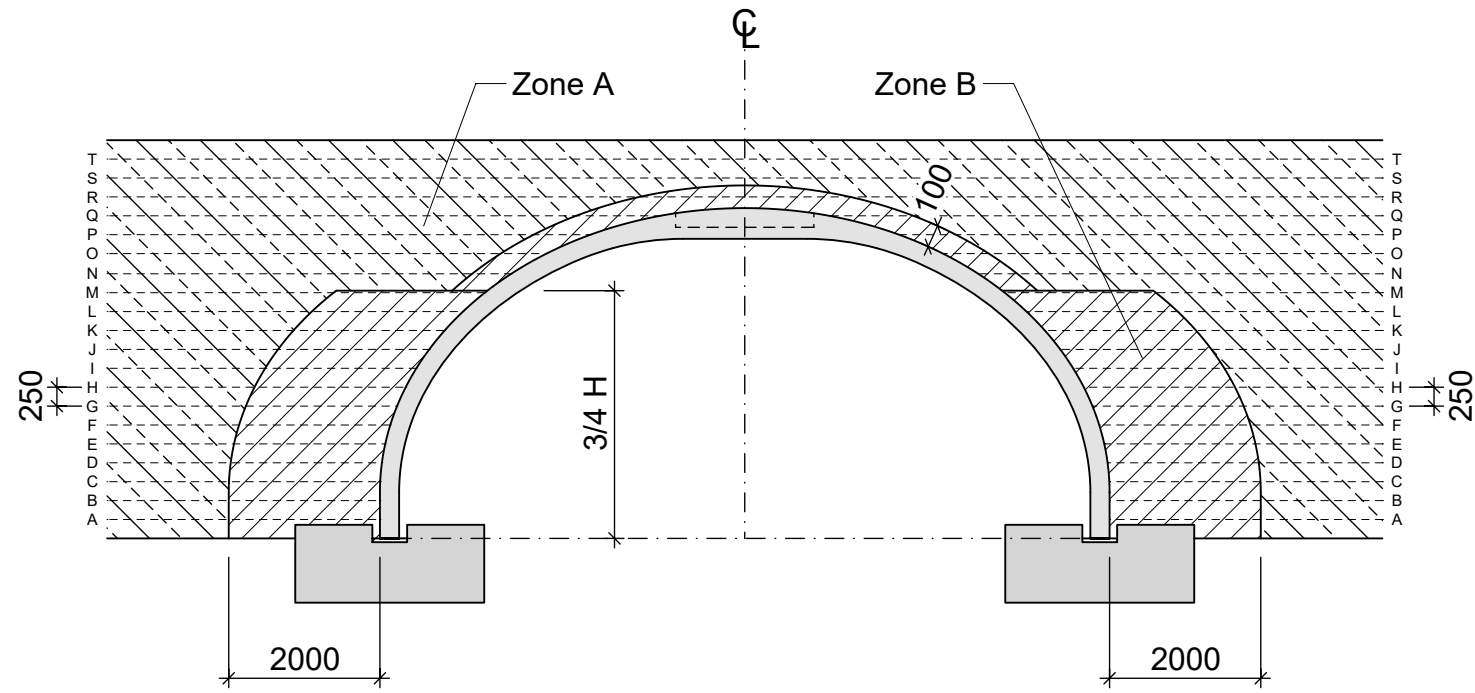
2.8. BACKFILL ZONES

- 2.8.1. ZONE A: EXISTING SOIL, CONSTRUCTED EMBANKMENT OR OVERFILL.
- 2.8.2. ZONE B: FILL WHICH IS DIRECTLY ASSOCIATED WITH PRECAST CONCRETE ARCH INSTALLATION.
- 2.8.3. ZONE C: ROAD STRUCTURE.

2.9. REQUIRED FILL PROPERTIES

- 2.9.1. ZONE A
 - 2.9.1.1. IF NOT IN DISAGREEMENT WITH THE AIP, ZONE A MATERIAL SHALL BE CLASS 1A AS PER MCRW - SPECIFICATION FOR ROAD WORKS - SERIES 600 EARTHWORK.
 - 2.9.1.2. NATURAL GROUND IS TO BE SUFFICIENTLY STABLE TO ALLOW EFFECTIVE SUPPORT TO THE PRECAST CONCRETE ARCH UNITS. AS A GUIDE, THE EXISTING NATURAL GROUND SHOULD BE OF SIMILAR QUALITY AND DENSITY TO ZONE A MATERIAL FOR A MINIMUM LATERAL DIMENSION OF ONE ARCH SPAN OUTSIDE OF THE ARCH FOOTING.
- 2.9.2. ZONE B
 - 2.9.2.1. ZONE B MATERIAL SHALL BE CLASS 6N OR 6P AS PER MCRW - SPECIFICATION FOR ROAD WORKS - SERIES 600 EARTHWORK.

SPECIFICATIONS FOR BACKFILL / OVERFILL PROFILE



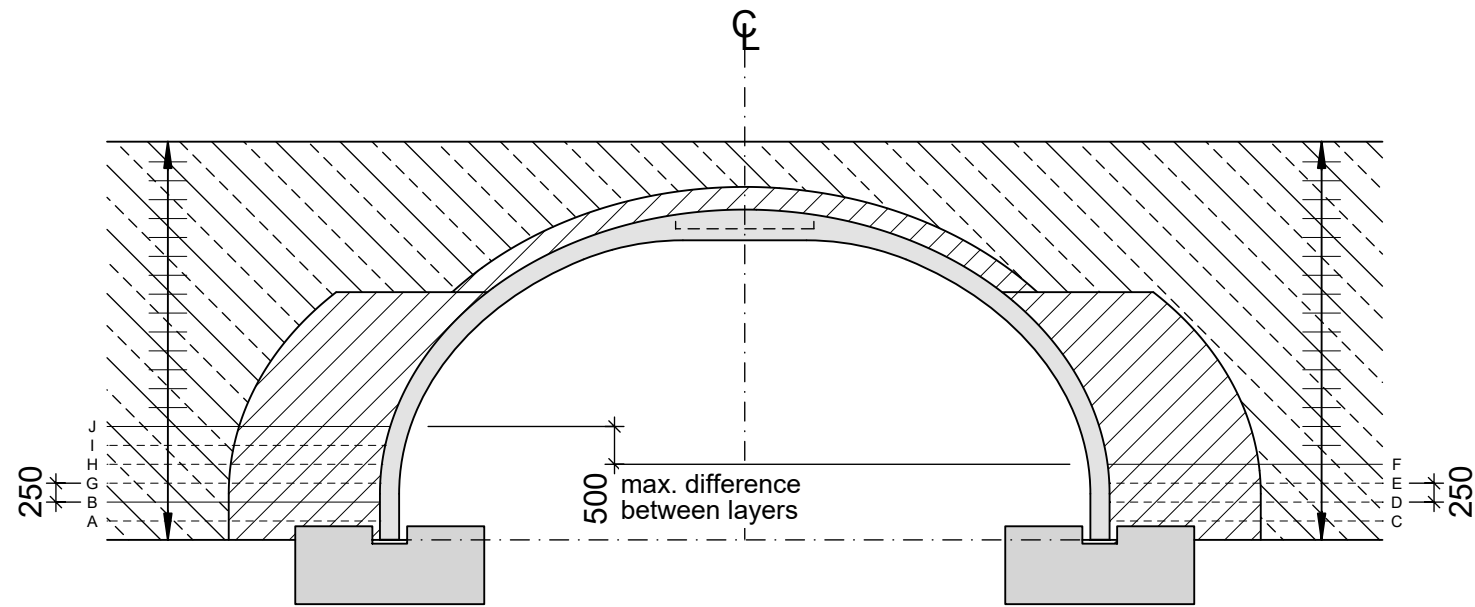
2.9.3. ZONE C

- 2.9.3.1. ZONE C (IF APPLICABLE) IS THE ROAD SECTION OF GRAVEL, ASPHALT OR CONCRETE BUILT IN COMPLIANCE WITH MCRW - SPECIFICATION FOR ROAD WORKS - SERIES 700 ROAD PAVEMENTS - GENERAL. MINIMUM OVERFILL HEIGHT IS 400MM OVER THE CROWN OF THE ARCH.
- 2.9.3.2. PRIOR TO SHIPPING THE PRECAST ARCH ELEMENTS, THE CONTRACTOR SHALL SUPPLY A CERTIFICATION LETTER BY A LICENSED SOILS TESTING FIRM OR REPRESENTATIVE STATING THAT THE BACKFILL SOIL MEETS THE REQUIREMENTS OF SECTION 2.9.2 ZONE B FILL MATERIAL.

2.10. PLACING AND COMPACTING OF FILL

- 2.10.1. UNLESS OTHERWISE SPECIFIED, BACKFILLING OPERATIONS SHOULD NOT BEGIN UNTIL THE GROUT OF THE ARCH KEY HAS ACHIEVED A DESIGN STRENGTH OF 25N/MM2 AND THE CONCRETE OF THE CROWN JOINT HAS REACHED THE SPECIFIED DESIGN STRENGTH.
- 2.10.2. DUMPING FOR BACKFILLING IS NOT ALLOWED ANY NEARER THAN 1 METER TO A VERTICAL PLANE THROUGH THE ARCH KEY.
- 2.10.3. THE FILL MUST BE PLACED AND COMPACTED AS PER MCRW - SPECIFICATION FOR ROAD WORKS - SERIES 600 EARTHWORK - FILL TO STRUCTURES IN LAYERS NOT EXCEEDING 250MM. THE MAXIMUM DIFFERENCE IN THE SURFACE LEVELS OF THE FILL ON OPPOSITE SIDES OF THE ARCH MUST NOT EXCEED 500MM.
- 2.10.4. THE BACKFILL OF ZONE B MUST BE COMPACTED TO A MINIMUM DENSITY OF 95% OF THE MAX. DRY DENSITY AS DETAILED IN TABLE 61: ACCEPTABLE EARTHWORKS MATERIALS: CLASSIFICATION AND COMPACTION REQUIREMENTS CLAUSE 612 AND TABLE 612: GRADING REQUIREMENTS FOR ACCEPTABLE EARTHWORKS MATERIALS.

BACKFILL PROCESS

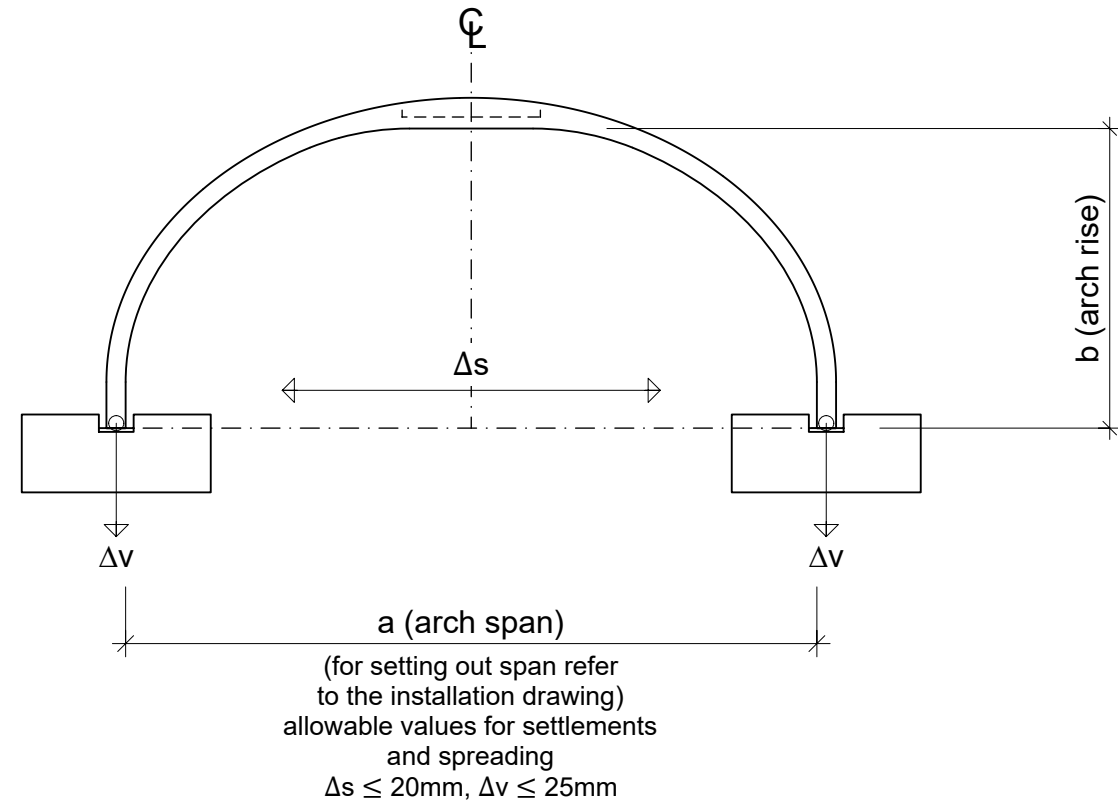


- 2.10.5. FILL WITHIN 300MM OF ALL CONCRETE SURFACES SHOULD BE HAND-COMPACTED (I.E. USING HAND-OPERATED EQUIPMENT VIBRO-TAMPER HAVING A MASS OF AT LEAST 250 KG, BUT NOT EXCEEDING 1500 KG). ELSEWHERE, USE OF ROLLERS IS ACCEPTABLE. IF VIBRATING ROLLER-COMPACTORS ARE USED, THEY SHOULD NOT BE STARTED OR STOPPED ABOVE THE STRUCTURE AND THE VIBRATION FREQUENCY SHOULD BE AT LEAST 30 REVOLUTIONS PER SECOND.
- 2.10.6. FILL MAY BE PLACED AT DIFFERENT LEVELS ALONG THE LENGTH OF THE STRUCTURE TO SUIT THE CONSTRUCTION SEQUENCE SO LONG AS 2.10.3 IS FOLLOWED IN EVERY SECTION. THE SLOPE LONGITUDINALLY SHOULD NOT EXCEED 1 IN 2, AND THE SLOPES SHALL BE CUT BACK TO ENSURE PROPER COMPACTION.

2.11. SETTLEMENTS AND HORIZONTAL DISPLACEMENTS

- 2.11.1. THE CONTRACTOR SHALL CHECK SETTLEMENTS AND HORIZONTAL DISPLACEMENT OF FOUNDATIONS TO ENSURE THAT THEY ARE WITHIN THE ALLOWABLE LIMIT. THESE MEASUREMENTS SHOULD GIVE AN INDICATION OF THE SETTLEMENTS AND DEFORMATIONS ALONG THE LENGTH OF THE FOUNDATIONS.

SETTLEMENTS AND HORIZONTAL DISPLACEMENTS



- 2.11.2. THE FIRST MEASUREMENT ROW SHOULD TAKE PLACE AFTER THE ERECTION OF ALL PRECAST ARCH SYSTEM ELEMENTS, A SECOND AFTER COMPLETION OF BACKFILLING, AND A THIRD BEFORE OPENING OF THE BRIDGE TO TRAFFIC. FURTHER MEASUREMENTS CAN BE MADE ACCORDING TO LOCAL CONDITIONS.
- 2.11.3. THE MAXIMUM DIFFERENCE IN VERTICAL DISPLACEMENTS 'V' SHOULD NOT EXCEED 25MM ALONG THE LENGTH OF ONE FOUNDATION.

2.12. TOLERANCES

- 2.12.1. THE ELEVATION OF ARCH CROWN UPON INSTALLATION SHALL BE WITHIN A TOLERANCE OF -0MM TO +50MM.

3. WEIGHT RESTRICTIONS FOR CONSTRUCTION MACHINERY

3.1. RESTRICTIONS FOR THE USE OF HEAVY CONSTRUCTION MACHINERY

- 3.1.1. IN THE IMMEDIATE VICINITY OF THE ARCH, THERE ARE RESTRICTIONS FOR THE USE OF HEAVY CONSTRUCTION MACHINERY DURING THE BACKFILLING OPERATION.
- 3.1.2. THE BARE ARCH MAY NOT BE CROSSED BY ANY CONSTRUCTION EQUIPMENT.
- 3.1.3. AFTER THE COMPACTED FILL LEVEL HAS REACHED A MINIMUM OF 150MM OVER THE CROWN OF THE ARCH, CONSTRUCTION EQUIPMENT WITH A MAXIMUM WEIGHT OF 10 TONNES MAY CROSS THE ARCH.

THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH:

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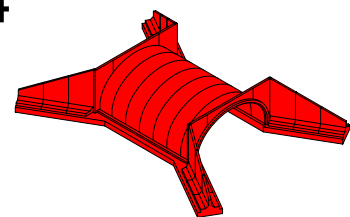
NOTE:
DO NOT SCALE FROM THIS DRAWING. ALL DIMENSIONS ARE IN MILLIMETRES. LEVELS ARE IN METRES. SCALES REFER TO PLOTS ON DRAWING SIZE SPECIFIED BELOW.

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BEBO SYSTEM						
NORTH LITTLEHAMPTON - E15.5mT/-4						
SPECIFICATIONS						
TEXT AND SKETCHES						
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