SECTION 941

PRECAST REINFORCED CONCRETE BARRIERS

941.01 Scope - This Section covers the quality and manufacture of precast reinforced concrete roadside and median barriers for highway and other off-highway traffic confinement use.

The concrete traffic barrier units shall be supplied in the sizes and types as required by the Purchase Order, Work Order or Drawing in strict conformity with this Section and pertinent Standard Drawings of the SP941 Series.

941.02 Concrete Quality

a) Concrete quality shall conform to CSA Standard CAN3-A23.1-M except where amended hereafter.

b) A compressive strength test result is defined as the average of the strengths of three 28 day compressive test cylinder breaks with a standard cylinder size of 150 mm diameter and height of 300 mm.

c) The strength level of the concrete represented by the test shall be considered satisfactory if the test result equals or exceeds 30 MPa and no individual cylinder strength is less than 27 MPa. If this condition is not met, the concrete will be considered to have failed the strength requirements. No other form of testing to prove the relative strength at a later date will be allowed without the approval of the Ministry Representative.

d) Concrete testing cylinders shall be cast by the Precast Supplier or his authorized representative at the time of placing concrete. Frequency of testing will be one cylinder collected at the start of the first pour; mid way and at the final pour of the concrete used for the making of the barrier with that batch run. Concrete cylinder samples may be collected by the Ministry Representative at any time and tested to ensure the concrete is meeting specification requirements.

e) Calcium chloride or admixtures containing calcium chloride shall not be used in the concrete.

f) Concrete shall meet the following additional requirements:

i) Minimum cement content of 320 kg per cubic metre.

ii) Maximum water/cement ratio of 0.45.

iii) Course aggregate of a nominal maximum size not exceeding 28 mm.

iv) Slump of 50 mm ± 20 mm.

v) Entrained air of 5 to 8%.

941.03 Reinforcing Steel, Fibrillated Fibres, Attachment Hardware & Miscellaneous Items

a) Welded steel wire mesh reinforcement shall be supplied and installed in each section as shown on the Standard Drawings, and in accordance with SS 412. Additional reinforcement may be installed to assist handling during the precasting operations but shall be subject to prior approval by the Ministry Representative.

b) Fibrillated Fibres (polyolefin or polypropylene or a blend of these fibres) are an acceptable substitute of welded wire mesh. Fibrillated fibres shall meet requirements of ASTM C 1116 Type 3 Synthetic Fibre Reinforced Concrete or shotcrete.

Fibres shall have a minimum length of 50 mm, added at a dosage rate of 1 kg/m³ (min of 0.1% by volume) and shall be thoroughly mixed with concrete before placement into the forms.

Fibres shall have a minimum tensile strength of 350 MPa and a minimum modulus of elasticity of 4.2 GPa.

Fibres are to be added early in the mixing process following manufacture’s recommendations to ensure evenly distributed fibres.

The Supplier/Manufacturer of the fibre must furnish test data in accordance with ASTM C 1018 and/or ASTM C 1399 to the Precast Supplier to show the fibre complies with the specification requirements as part of the Precast Supplier’s Quality Control.

When the fibre option is used, a single length of 15 mm rebar shall be wire tied to the horizontal sections of the hook or eye assemblies as shown on the Standard Drawings.

Steel fibres shall not be used in the concrete mix for concrete barriers.

c) Reinforcing steel for bent and hooked connections shall conform to CSA CAN3-G40.21-M Grade 260W and shall be carefully bent to the radii detailed and installed as shown on the Standard Drawings.

Bending shall be done by methods that will not produce fracture or other injury. The metal heating shall not be to a higher temperature than that producing a "dark cherry red" colour. After heating, the metal shall be cooled as slowly as possible. Following the bending, the surface of the metal shall be carefully inspected for evidence of fracture, and any fractured pieces shall be replaced.

Prior to delivery, exposed surfaces of connections shall be prepared for and given a heavy application of zinc rich coating to CGSB Standard 1-GP-181M.

d) Pick-up points for handling units shall be formed with accurately placed rigid P.V.C. pipe recessed 15 mm from both finished surfaces as detailed.

941.04 Optional Features - Where barrier is ordered with drainage slots or grouting holes or both, they shall be accurately cast-in as detailed. Facilities for the installation of anti-glare screens will be detailed as and when required.
941.05 Placing and Finishing of Concrete

a) Concrete shall be placed in the forms and carefully consolidated in strict accordance with CSA CAN3-A23.4-M, Clause 19.

b) Curing and protection shall be carried out strictly according to CSA CAN3-A23.4-M Clause 21.

i) Curing shall be considered complete when test cylinders reach the specified 28 day compressive strength provided such strength is reached not later than 28 days after the barriers are cast.

ii) Steam curing is permissible for either the entire curing period or portion thereof and shall be carried out in accordance with CSA CAN3-A23.4-M Clause 21.4.

iii) At no time during or at completion of the curing period shall the temperature differential between the concrete surface and the ambient temperature be greater than 20°C.

iv) If steam is used for a portion of the curing period, additional normal curing shall be carried out after the steam curing, according to CSA CAN3-A23.4-M Clause 21.3 until such time as strength tests of concrete test cylinders that have been both steam and normally cured with the barriers reach the specified concrete strength.

c) Exposed surfaces shall be uniform in texture and colour as produced from well maintained steel form surfaces and proper vibration methods without excessive surface fines or laitance.

d) Defects of the exposed surface will normally be cause for the rejection of any unit except where such are within the permissible limits or are subject to making good as follows:

i) Unobtrusive defects of any kind where their total area is not in excess of 2% of the exposed surface area of the unit.

ii) Air holes not greater than 3 mm in diameter and not more than 20 holes in any isolated 300 mm X 300 mm area.

iii) Sharp protrusions at the edges of the exposed surfaces where necessary shall be softened by careful rubbing or grinding.

iv) Patching of isolated small holes, cavities and similar self-confining defects may be permitted when authorized in writing by the Ministry Representative.

e) Patching, only when authorized, shall have the defective area well saturated with water and the defect prepared with cement paste and filled with mortar. The mortar, properly proportioned of the same sand and cement as the original concrete and reasonably colour matched to the cured dry unit with the addition of white cement where necessary, shall be pre-shrunk for about one hour before retempering and use. The patching mortar shall be well tooled in, finished flush and smooth and the area covered to cure adequately.

f) End connection surfaces shall be cleared out.

g) All concrete surfaces prior to shipment shall be accurate to detail and, in particular at the end connections, true to dimension tolerances.

941.06 Tolerances – Allowable Tolerances for the concrete dimensions of the barriers shall be ± 3 mm except as otherwise indicated on the detail drawings.

941.07 Procedure of Manufacture - The Supplier shall notify the Ministry in advance concerning the date when the order is to be manufactured, so that detailed inspection can be carried out. All processes shall be open for inspection and approval by the Ministry Representative. No material shall be shipped prior to the inspection or written release for shipment by the Ministry Representative.

The manufacturer's name or trade mark, year of manufacture and form number shall be embedded on the end of each unit in a manner, size and depth that are permanently legible.

Authorized patching or making good may be inspected before shipment or upon delivery and the rejected unit(s) shall be replaced at no cost to the Ministry.

941.08 Handling - In handling the finished product, the concrete and connecting devices shall not be damaged or distorted.

941.09 Payment - Payment shall be at unit price bid per unit (section). The price bid shall be full compensation for everything furnished and done including supply of forms and all materials, placing, vibrating and curing air entrained concrete, concrete testing, stripping, finishing, general clean-up and delivery.
GENERAL NOTES:
1. FOR VIEW (A) & (B) SEE SP941–01.01.02
2. FIBRILATED FIBRE STRAND REINFORCED CONCRETE TO BE USED FOR BULL–NOSE (CBN).
3. FIBRILLATED FIBRE STRAND REINFORCED CONCRETE MAY BE SUBSTITUTED FOR STEEL REINFORCED CONCRETE IN LOW BARRIER (CLB–H & E).
4. MATERIALS AND QUALITY OF WORK TO BE IN ACCORDANCE WITH SECTION 941.
5. STANDARD CBN–E MAY BE MANUFACTURED ONLY WITH PRIOR WRITTEN PERMISSION FROM THE HIGHWAY SAFETY BRANCH.

NOT TO SCALE  ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

BC MoT  2016  941 (3 of 30)
GENERAL NOTES:
1. FOR SECTION E SEE SP941–01.02.02. FOR VIEW F SEE SP941–01.02.03.
2. SEE DRAWING SP941–01.02.02 FOR DETAILS OF EYE UNIT.
3. ALL REINFORCING TO HAVE 50 MINIMUM COVER EXCEPT AS NOTED.
4. ALL TOLERANCES ±3 mm EXCEPT AS NOTED.
5. CHANGES TO PICK-UP HOLE DIAMETERS MAY BE MADE WITH THE WRITTEN PERMISSION OF THE HIGHWAY SAFETY ENGINEER.
6. HOOK AND EYE ANCHORS EACH END SHALL BE SECURED IN PLACE DURING CASTING TO PREVENT DILLODGMEMENT.
7. MATERIALS AND QUALITY OF WORK TO BE IN ACCORDANCE WITH SECTION 941.
8. DRAINAGE SLOT IS REQUIRED WHEN NECESSARY TO DRAIN SURFACE WATER THROUGH THE BARRIER.
9. SHEAR KEY VOID WITH GROUTING HOLES BY REQUEST. SEE SP941–04.02.01.
10. FIBRILLATED FIBRE STRAND REINFORCED CONCRETE MAY BE SUBSTITUTED FOR WELDED WIRE MESH REINFORCED CONCRETE.

NOT TO SCALE  ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
NOTES:
1. FOR VIEW G SEE SP941–01.02.04.
2. FOR GENERAL NOTES SEE SP941–01.02.01
3. SEE DRAWING SP941–01.02.01 FOR DETAILS OF HOOK UNIT.

NOT TO SCALE  ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
NOTES:
1. FOR LOCATION OF VIEW SEE SP941–01.02.01, SP941–03.02.01, SP941–03.03.01 & SP941–03.03.03.
2. FOR GENERAL NOTES SEE SP941–01.02.01
3. FOR DETAILS OF ANCHORS SEE SP941–04.01.01.
4. THE CONNECTION DIMENSIONS ON A CRB–E UNIT PERMIT INSTALLATION TO A MINIMUM HORIZONTAL CURVE RADIUS OF 51 METRES. FOR TIGHT CURVATURE INSTALLATION SEE SP941–02.01.08 & SP941–02.01.09.

NOT TO SCALE ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
SECTION 941

PRECAST REINFORCED CONCRETE BARRIERS

PRECAST CONCRETE DRAINAGE BARRIER (SPECIAL USE)
690 mm – CDB–E DETAILS

SP941–01.02.05

NOTES:
1. FOR VIEW SEE SP941–01.02.04.
2. SEE SP941–01.02.01 FOR DETAILS OF CONNECTING HOOK UNIT.
3. FOR GENERAL NOTES SEE SP941–01.02.01
4. FIBRILLATED FIBRE STRAND REINFORCED CONCRETE MAY BE SUBSTITUTED FOR WELDED WIRE MESH REINFORCED CONCRETE. ADDITIONAL BARS AND TIES WILL STILL APPLY.
5. THIS LARGE OPENING DRAINAGE BARRIER WAS DEVELOPED TO BE USED IN CONJUNCTION WITH A PAVED SPILLWAY AT THE BOTTOM OF SAG CURVES. IT MAY BE APPROPRIATE FOR USE AT OTHER LOCATIONS WHERE A SIGNIFICANT VOLUME OF WATER REQUIRES AN OUTLET THAT CANNOT BEHandled BY CRB WITH A 65 mm DRAINAGE SLOT.

NOT TO SCALE ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

BC MoT 2016 941 (9 of 30)
NOTES:
1. FOR SECTION \( \mathbb{K} \) SEE SP941–02.01.02 FOR VIEW \( \mathbb{L} \) SEE SP941–02.01.03.
2. FOR GENERAL NOTES SEE SP941–01.02.01
3. SEE DRAWING SP941–02.01.02 FOR DETAILS OF EYE UNIT.

NOT TO SCALE     ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
NOTES:
1. FOR LOCATION OF VIEW L SEE SP941−02.01.01 & SP941−03.02.01.
2. FOR GENERAL NOTES SEE SP941−01.02.01.
3. FOR DETAILS OF ANCHORS SEE SP941−04.01.01.
4. THE CONNECTION DIMENSIONS PERMIT INSTALLATION TO A MINIMUM HORIZONTAL CURVE RADIUS OF 95.5 METRES.

NOT TO SCALE  ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
NOTES:
1. FOR LOCATION OF VIEW M SEE SP941–02.01.02.
2. FOR GENERAL NOTES SEE SP941–01.02.01.
3. FOR DETAILS OF ANCHORS SEE SP941–04.01.01.
4. THE CONNECTION DIMENSIONS PERMIT INSTALLATION TO A MINIMUM HORIZONTAL CURVE RADIUS OF 95.5 METRES.

NOT TO SCALE  ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
NOTES:
1. FOR SECTION P SEE SP941–02.01.06.
   FOR VIEW Q1 & Q2 SEE SP941–02.01.07.
2. FOR GENERAL NOTES SEE SP941–01.02.01
3. SEE DRAWING SP941–02.01.06 FOR DETAILS
   OF EYE UNIT.
4. THESE UNITS ARE INTENDED TO BE USED AGAINST BRIDGE
   SUPPORT STRUCTURES AND SIMILAR WALLS.
5. IT IS INTENDED THAT EXISTING CMB MOLDS WILL BE
   ADAPTED TO PRODUCE THESE CPB UNITS.

NOT TO SCALE     ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
SECTION 941 PRECAST REINFORCED CONCRETE BARRIERS

NOTES:
1. FOR VIEW R1 & R2 SEE SP941–02.01.07.
2. FOR GENERAL NOTES SEE SP941–01.02.01
3. SEE DRAWING SP941–02.01.05 FOR DETAILS OF HOOK UNIT.
4. THESE UNITS ARE INTENDED TO BE USED AGAINST BRIDGE SUPPORT STRUCTURES AND SIMILAR WALLS.
5. IT IS INTENDED THAT EXISTING CMB MOLDS WILL BE ADAPTED TO PRODUCE THESE CPB UNITS.

NOT TO SCALE  ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
NOTES:
1. THIS DRAWING MUST BE READ WITH CRB DRAWINGS SP941–01.02.01 TO 941–01.02.04 FOR FULL DETAILS OF UNITS.
2. IT IS INTENDED THAT EXISTING CRB MOLDS BE ADAPTED TO DIMENSIONS NOTED ON THIS DRAWING TO PRODUCE UNITS CAPABLE OF BEING PLACED TO A MINIMUM CURVE RADIUS OF APPROXIMATELY 17 m.
3. ALL TOLERANCES AS PER CRB UNIT DRAWINGS.
4. THIS MODIFIED UNIT IS INTENDED TO BE USED ON TIGHT CURVATURE AT INTERSECTIONS ONLY.

HOOK KEY MADE SMALLER BY USE OF 6 mm PLATE INSERT ON BOTH KEY ENDS, AND 3 mm PLATE INSERTS ON BOTH SIDES OF KEYS DURING CASTING.

NOT TO SCALE  ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
NOTES:
1. THIS DRAWING MUST BE READ WITH CRB DRAWINGS SP941–01.02.01 TO 941–01.02.04 FOR FULL DETAILS OF UNITS.
2. IT IS INTENDED THAT EXISTING CRB MOLDS BE ADAPTED TO DIMENSIONS NOTED ON THIS DRAWING TO PRODUCE UNITS CAPABLE OF BEING PLACED TO A MINIMUM CURVE RADIUS OF APPROXIMATELY 17 m.
3. ALL TOLERANCES AS PER CRB UNIT DRAWINGS.
4. THIS MODIFIED UNIT IS INTENDED TO BE USED ON TIGHT CURVATURE AT INTERSECTIONS ONLY.

CRB–E END (ONE SIDE ONLY) FLARED 38 mm, BOTH ENDS, DURING CASTING

NOT TO SCALE  ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
SECTION 941 PRECAST REINFORCED CONCRETE BARRIERS

PRECAST CONCRETE MEDIAN DRAINAGE BARRIER
810 mm – CMDB-E DETAILS

NOTES:
1. FOR VIEW M SEE SP941-02.01.04.
2. SEE SP941-02.01.01 FOR DETAILS OF CONNECTING HOOK UNIT.
3. FOR GENERAL NOTES SEE SP941-01.02.01
4. FIBRILATED FIBRE STRAND REINFORCED CONCRETE MAY BE SUBSTITUTED FOR WELDED WIRE MESH REINFORCED CONCRETE. ADDITIONAL BARS AND TIES WILL STILL APPLY.
5. FOR DETAILS NOT SHOWN SEE SP941-02.01.02

NOT TO SCALE ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
SECTION 941 PRECAST REINFORCED CONCRETE BARRIERS

PRECAST CONCRETE TRANSITION BARRIER
690 mm TO 460 mm – CTB-1E

SP941-03.01.01

ELEVATION

80ø HOLE (TYP.)
15x45° CHAMFER B.S.

1–15M BAR IN CENTRE LOOSELY TIED TO ANCHORS. (FIBRILLATED FIBRE REINFORCED CONCRETE ONLY)

ANCHOR MK E2
SEE SP941-04.01.01

MATCH WITH:
CRB-H
(SP941-01.02.01)
OR CTB-2H
(SP941-03.02.01)

ANCHOR MK E1
SEE SP941-04.01.01

MATCH WITH:
CBN-H
(SP941-01.01.01)

NOTES:
1. FOR VIEW B SEE SP941-01.01.02. FOR VIEW G SEE SP941-01.02.04.
2. FOR GENERAL NOTES SEE SP941-01.02.01.
3. SEE DRAWINGS SP941-01.01.01 AND SP941-01.01.02 FOR DETAILS OF 460 mm UNIT AND BULLNOSE.
SEE DRAWING SP941-01.02.01 FOR DETAILS OF 690 mm HOOK UNIT OR SP941-03.02.01 FOR DETAILS OF 810 TO 690 TRANSITION UNIT.

NOT TO SCALE ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

941 (20 of 30) 2016 BC MoT
SECTION 941
PRECAST REINFORCED CONCRETE BARRIERS

PRECAST CONCRETE TRANSITION BARRIER
810 mm TO 690 mm – CTB–2H

NOTES:
1. FOR VIEW 6 SEE SP941–01.02.03.
   FOR VIEW 1 SEE SP941–02.01.03.
2. FOR GENERAL NOTES SEE SP941–01.02.01.
3. SEE DRAWING SP941–02.01.02 FOR DETAILS OF 810 mm EYE UNIT.
   SEE DRAWING SP941–01.02.02 FOR DETAILS OF 690 mm EYE UNIT
   OR SP941–03.01.01 FOR DETAILS OF 690 TO 460 TRANSITION UNIT.

NOT TO SCALE  ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
SECTION 941

PRECAST REINFORCED CONCRETE BARRIERS

PRECAST CONCRETE TRANSITION BARRIER
686 mm TO 690 mm – CTB–3H

PLAN

ELEVATION

NOTES:
1. FOR VIEW F SEE SP941–01.02.03. FOR VIEW S SEE SP941–03.03.02
2. FOR GENERAL NOTES SEE SP941–01.02.01
3. SEE DRAWING SP941–01.02.02 FOR DETAILS OF 690 mm EYE UNIT.
4. THIS UNIT TO BE USED WITH EXISTING 27" BARRIER. 27" BARRIERS ARE NO LONGER USED IN NEW INSTALLATIONS

NOT TO SCALE ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

941 (22 of 30) 2016 BC MoT
NOTES:
1. FOR LOCATION OF VIEW S SEE SP941−03.03.01
2. FOR GENERAL NOTES SEE SP941−01.02.01
3. FOR DETAILS OF ANCHORS SEE SP941−04.01.01.

NOT TO SCALE            ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
SECTION 941
PRECAST REINFORCED CONCRETE BARRIERS

PRECAST CONCRETE TRANSITION BARRIER
686 mm TO 690 mm – CTB–3E+H

SP941–03.03.03

NOTES:
1. FOR VIEW F SEE SP941–01.02.03. FOR VIEW U SEE SP941–03.03.04
2. FOR GENERAL NOTES SEE SP941–01.02.01
3. SEE DRAWING SP941–01.02.01 FOR DETAILS OF 690 mm HOOK UNIT.
4. THIS UNIT TO BE USED WITH EXISTING 27" BARRIER. 27" BARRIERS ARE NO
   LONGER USED IN NEW INSTALLATIONS

NOT TO SCALE  ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

941 (24 of 30)  2016  BC MoT
NOTES:
1. FOR LOCATION OF VIEW U SEE SP941–03.03.03.
2. FOR GENERAL NOTES SEE SP941–01.02.01
3. FOR DETAILS OF ANCHORS SEE SP941–04.01.01.

NOT TO SCALE ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
SECTION 941

STANDARD BRIDGE PARAPET
810 mm HIGH TRANSITION

PLAN

WELDED WIRE FABRIC
102x102xMW25.8

ANCHOR MK H2. SEE
SP941-04.01.01

80Ø PICK-UP HOLE
15x45° CHAMFER (TYP.)

ANCHOR MK H3. SEE
SP941-04.01.01

RIGHT-HAND TRANSITION

ELEVATION

KEY VOID
SEE DETAIL
SP941-03.04.02

810

LEFT-HAND TRANSITION

NOTES:
1. FOR VIEW X AND Y SEE SP941-03.04.02
2. FOR GENERAL NOTES SEE SP941-01.02.01

NOT TO SCALE
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
SECTION 941 PRECAST REINFORCED CONCRETE BARRIERS

STANDARD BRIDGE PARAPET
810 mm HIGH TRANSITION – DETAILS

ACCEPTABLE ALTERNATE SIDE CONFIGURATION
RIGHT HAND TRANSITION ELEVATION SHOWN
LEFT HAND TRANSITION ELEVATION OPPOSITE HAND

NOTES:
1. FOR LOCATION OF VIEW X AND Y SEE SP941–03.04.01
2. FOR GENERAL NOTES SEE SP941–01.02.01

NOT TO SCALE ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

BC MoT 2016 941 (27 of 30)
NOTES:
1. STEEL FOR ANCHORS TO CONFORM TO CSA SPECIFICATION CAN3-040.21M.
2. PRIOR TO DELIVERY, EXPOSED SURFACES OF CONNECTIONS SHALL BE PREPARED FOR AND GIVEN A HEAVY APPLICATION OF ZINC-RICH COATING TO CAN/CGSB–1.181–99.
NOTES:
1. 690 HIGH CRB AS SHOWN, 810 HIGH CMB SIMILAR.
2. FOR DETAILS OF 690 CRB SEE SP941–01.02.01 & SP941–01.02.02. FOR DETAILS OF 810 CMB SEE SP941–02.01.01 & SP941–02.01.02.
3. DRAINAGE SLOTS ARE NOT ALLOWED IN BARRIERS WHEN SHEAR KEYS ARE REQUIRED.

NOT TO SCALE        ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED