BRIDGE STANDARDS AND PROCEDURES

PREFACE

The Bridge Standards Committee has expended a high level of effort in the preparation, expansion and revamping of the Manual of Bridge Standards and Procedures since its inception in 1986 by Peter H. Brett, P.Eng, Director of Bridge Engineering. The format has been designed to facilitate additions and revisions on a regular basis.

The Manual of Bridge Standards and Procedures currently covers the following sections:

i. Chapter A - Office Procedures
ii. Chapter B - Design Standards
iii. Chapter C - Drafting Standards
iv. Commentary
v. Standard Drawings

The Design Standards in Chapter B shall be used in conjunction with CAN/CSA-S6-88 and, in general, the highway loading shall refer to CS-600. The Commentary will be useful in explaining the underlying rationale for the Manual of Bridge Standards and Procedures.

Standard Drawings for Aluminum Railing, Timber Railings, Concrete Bridge Parapet, Steel Sidewalk and Bicycle Fences, Prestressed Concrete Twin Cell and Single Cell Box Stringers and "I" Beams have been included in the Manual. The Drawings for prestressed stringers and beams are intended to serve as guidelines to the configuration and geometry of the sections and all constraints in the design codes relating to concrete strength, number of strands and rebars shall be compiled with by the Design Engineer.

The Special Provisions consists of the Master Draft for Section 2 - Construction and Payment; Appendices on Post-Tensioned Concrete Members, Precast and Prestressed Concrete Members; Maintenance Painting of Old Steelwork, Foundation Excavation and Backfill, Ministry's Site Office, Quality Control Programs for Precast Concrete Fabrication Firms and Coating of Steelwork, Installation/Removal of Acrow/Bailey Bridges, and Order of Contents in Microsoft Word Version 2.0. The other documents are available in the "Standard Specifications for Highway Construction."

This manual is intended for the use of professional personnel competent to evaluate the significance and limitations of its content and recommendations, and who will accept responsibility for the application of the material it contains. The authors and the Ministry of Transportation and Highways disclaim any and all responsibility for the application of the stated standards and for the accuracy of the material contained herein.

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- **B.17.1 Shear Keys**

B.1.1 Scope

The **Design Standards** shall be used in conjunction with **CAN/CSA-S6-88** and shall be subject to periodic review and amendments. In general, the highway loading shall refer to **CS-600.**

B1.2 Skews

a) Prestressed concrete Box and Single Cell Box Stringers

Max 30° in 5° increments.

b) Prestressed Concrete I-Beams

Skews over 30° shall be avoided. For skews over 30° sharp corners at ends of stringers shall be chamfered as a precaution against breakage.

B.1.3 Installation of Utilities

The installation of utilities on new and existing bridge structures shall be approved by the **Bridge Inspection Engineer.**

B.1.4 Application for Construction Under the Navigable Water Protection Act

When a bridge spans **"Navigable Waters,"** an application to construct must be made to the **Federal Government** under the **Navigable Waters Protection Act** and the **Rail, Navigable Waters** shall contact the **Coast Guard** about clearance provisions and safety appurtenances.

"Navigable Waters" are described as any body of water, natural or man made, capable of carrying a water borne vessel. If the body of water is considered to be marginal for navigation, a review will take place by the **Rail, Navigable Waters Coordinator**, in communication with the **Coast Guard** and any **Harbours Board** or other authority having jurisdictional responsibilities for the **Navigable Waters Protection Act.** To allow this evaluation, several pictures of the watercourse and a location description are required.

In general, **Navigable Waters** require a vertical clearance capable of allowing passage of the largest airdraft vessel at the 100 year flood level or the Extreme High Tide Water Level. For small watercourses capable of carrying only canoes, kayaks and other small craft, a clearance of 1.7 meters above the 100-year flood level is considered adequate. The **Coast Guard**, having authority of works over or in **Navigable Waters**, can declare other clearance requirements.

The **Coast Guard** can also indicate the preferred location, alignment and dimension of navigable channel(s) and markers (etc.) to ensure the safety of water users. In general, piers should be aligned within 10 degrees of river flow (possibly 20 degrees for very slow moving water) and have smooth and continuous faces.

Reconstruction of a previously approved structure does not require a full application if the work does not alter the physical dimension of the navigable channel.

Temporary works, facilities and equipment that may be present in any navigable area or works that require temporary alteration to the operation of a moveable span must be coordinated by the **Rail, Navigable Waters Coordinator** with the **Coast Guard, Harbours Board** and known mariners. Notice to Mariners, advertising, warning signs, and occasionally mitigation, may be required to ensure the safety of work crews and mariners. For larger contracts and when construction procedures are now known in detail, limits of temporary works and communication procedures will be written in the contract.

B.1.4 Application for Construction Under the Navigable Water Protection Act (continued)

The preferred procedure for filling the application is as follows:

1. As soon as the general details of the structure are known, a general layout drawing, entitled **"NWPA Application Layout"** is prepared. General details often require negotiation with the **Coast Guard** and **Harbour Board** to ensure the proposed design is conceptually satisfactory.

   The drawing should include:

a) Plan and elevation of the bridge including illumination lighting and navigational lights and markers
b) Direction of water flow
c) Section of bridge showing river pier and general construction details
d) Kay map (including Longitude and Latitude)
e) Road name
f) Bearings of bridge
g) Width of water lot
h) Width and location of water course with contours and the navigation channel in the area of the bridge
i) Clearance above 100 year flood level in non-tidal waters or the Extreme High Tide Water level
j) Legal description of property at each end of the bridge
k) Standard note that a duplicate has been filed in the appropriate **Land Titles Office**
l) Location and description of nearby existing structures and a note if they are to be removed
m) The vertical clearance above 100 year flood level in non-tidal waters or the Extreme High Tide Water Level of the existing bridge. This drawing should be used for the **NWPA** application only.
n) An Environmental checklist is to be filled out by the Project Manager or Environmental Coordinator and forwarded to the **Rail, Navigable Waters Coordinator** along with relevant environmental reports (four copies), correspondence and environmental contact list.

B.1.4 Application for Construction Under the Navigable Water Protection Act (continued)

2 The completed drawing and environmental information is handed to the **Rail, Navigable Waters Coordinator** who is responsible for continuing this application process. This drawing should not be used for construction purposes.

3. A reproducible of the drawing is sent to the appropriate **Land Titles Office** with a request to return it certified to deposit a copy in his office.

"I certify that a duplicate of this plan was deposited in the Land Title Office at _____, Province of British Columbia, on the _____ day of _____ 19___, under the Provisions of the Navigable Waters Protection Act.

_____

Registrar"

4. The formal application is made to **Canada Fisheries and Oceans, Canadian Coast Guard in Vancouver** with **ten copies** of the drawing and four copies of environmental information. Copies are forwarded to the Project Manager or Designer, Regional Director and the District Highways Manager. The letter should describe any features which minimize the impact on navigation, the proposed date of construction, and any temporary conditions that may be known or stipulated in the contract. Normally approval takes at least **six months**; therefore, it is imperative that the process start at the earliest possible date.

5. When **Canada Fisheries and Oceans, Canadian Coast Guard** has completed its initial investigation, they will advise the **Ministry** that it is in order to advertise the project.

6. The project is advertised in at least two local newspapers and in the **Canada Gazette.**

7. After waiting for one month, the proof of advertising is sent to **Canada Fisheries and Oceans, Canadian Coast Guard**. If there have been no objections to the project, the formal approval will be issued in due course.

8. A copy of the approval document and the conveying letter are sent to the **Project Manager or Designer, Regional Director and District Highways Manager.**

B.1.5 Application for Construction of Railway Overheads and Underpasses

When a bridge spans railways, an application to construct must be made to the **Railway Authorities** and the **Rail, Navigable Waters Coordinator** shall contact the Railway about future provisions of facilities and safety appurtenances. The preferred procedure for filing the application is as follows:

1. As soon as the general details of the structure are known, a general layout drawing, entitled "**Application Layout**" is prepared.

The drawing should include:

a) Plan and elevation of the bridge
b) Section of bridge showing pier and general construction details
c) Key map (longitude and latitude)
d) Road name
e) Bearings of bridge, angle of crossing, name of Railway, railway mile and subdivision
f) Width of right-of-ways
g) Width and location, railway clearances including future railway facilities
h) Location of existing and future railway utilities
i) Legal description of property at each end of the bridge
j) Standard note on construction required by Railway Authorities
k) Location and description of existing nearby structures and if they will be removed or modified
l) Details of drainage of structure and adjacent area.

2. The completed drawing is handed to the **Rail, Navigable Waters Coordinator** who is responsible for continuing this application process. This drawing should not be used for construction purposes.

3. a) Federally chartered railways are governed by Acts and Regulations under the authority of the **Railway Safety Directorate** and **Canadian Transportation Agency.** The **Rail, Navigable Waters Coordinator** will negotiate with the railway for cost and facility responsibilities and, if possible, conclude an agreement allowing the (re)construction of the facility. The agreement is then passed to the **Canadian Transportation Agency** to provide an Order filing the agreement and attesting to its completeness. The **Railway Safety Act** requires that a Notice be issued describing the proposal at least 60 days before the commencement of construction.

B.1.5 Application for Construction of Railway Overheads and Underpasses (cont'd)

3. b) If an agreement cannot be concluded with the railway company, the **Canadian Transportation Agency** can resolve disputes and will issue an Order authorizing construction providing all the responsibilities and conditions. The **Canadian Transportation Agency** will, by law, require that an environmental report be attached to any application for resolution.

4. Provincially chartered railways are governed by Acts and Regulations under the authority of the **Ministry of Municipal Affairs.** The **Rail, Navigable Waters Coordinator** will negotiate with the railway for cost and facility responsibilities and, if possible, conclude an agreement allowing (re)construction of the facility. An application is then made to the **Ministry of Municipal Affairs** for the issuance of a Certificate allowing construction.

5. The application, in general terms, should describe the roadway traffic effects and the cost sharing requests, the proposed date of construction and any construction allowances that may be required. Normally, approval takes about **six months**; therefore, it is imperative that the process starts at the earliest possible date.

6. A copy of the approval document and the conveying letter are sent to the **Project Manager/Design Coordinator, Regional Director** and **District Highways Manager.**

B.1.6 Limits for Girder Transportation - Weights and Dimensions

Girders which require transportation by truck on the highway system shall be seized in order that the following limits are not exceeded:

Length	**47.5 m out to out including truck**
Width	**4.4 m**
Weight	**64 tonnes including truck (GVW)**

(Possible exemptions: Lower Mainland Horseshoe Bay to Langley - 81 tonnes)

If particular girders are close to the guidelines or if a slightly larger girder is required, the design engineer should inquire with the heavy haul division of **Arrow Transport, Davey Cartage and Rocky Mountain**, where applicable, to see if the above limiting constraints can be met.

The approximate limiting constraints for steel girders are the maximum length of 41.5 metres or weight of 43,500 kg.

B.1.6 Limits for Girder Transportation - Weights and Dimensions (cont'd)

The approximate limiting constraints for prestressed concrete girders are the maximum length of 39 metres or weight of 43,000 kg. Girder weights shall be calculated using concrete densities of 2650 kg/m^3 for I-Girders and 2720 kg/m^3 for box girders to provide allowance for spread of formwork and higher reinforcing steel densities.

For the transportation of very short heavy sections, trucking companies should be consulted for girder weights that will meet bridge overload formula and 64 tonne maximum G.V.W.

The design engineer shall determine and verify whether the girder of a particular length and weight can be transported to the bridge site, viz, negotiating tight corners and switchbacks and complying with posted load limits on bridges en route.

B.1.7 Slope Pavements

Slope paving shall be carried out for overpasses and underpasses for aesthetic reasons and the width of the slope pavement shall match the width of the bridge deck. Slope paving is not required for overheads.

B.1.8 Approach Slabs

The use of approach slabs on paved roads shall be based on site specific conditions. The approach slabs shall be 6 metres in length, located at least 150 mm below the finished grade, anchored to the abutments and shall be as wide as the deck. A cover of 70 mm shall be used for the top reinforcing bars.

B.1.9 Sidewalk Railing

The standard sidewalk railing shall extend 3 metres beyond the bridge abutments.

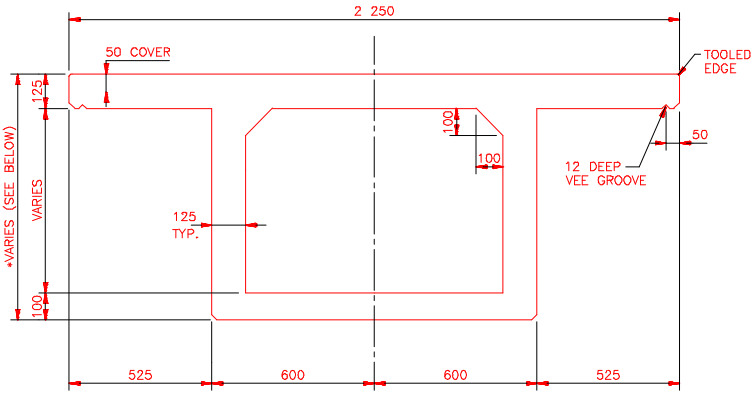
B.1.10 Utilities on Bridges

For procedures and guidelines on installation of utilities on or near bridges, see the Ministry's "Utility Policy Manual," issued by the Highway Planning Branch.

B.1.11 Pedestrian Bridges

A maximum gradient of 1:12 shall be used for wheelchair traffic on ramps. The distance between the inside faces of railings shall be 2 metres.

At locations where there is a change in gradient at the piers, the provision of a smooth curve on the cast-in-place section over the piers shall be considered for improving the aesthetics



TYPICAL SECTION

* 900mm – (20m–25m SPAN)
1 100mm – (25m–30m SPAN)
1 200mm – (30m–35m SPAN)
1 300mm – (35m–40m SPAN)

B.2.1 Roadway Widths on Bridges

Roadway widths for major highways shall be in accordance with **Fig. B.1 and Tables B.1 and B.2.**

Roadway widths for collector highways and resource highways shall be in accordance with **Figs. B.2 and B.3 and Tables B.3 and B.4.**

Roadway widths for expressways and freeways shall be determined by the Senior Bridge Design Engineer at the commencement of the project.

The overall bridge width between cubs, or between railings, shall be equal to or greater than the approach roadway. Any deviation from this requirement shall be referred to the **Director of Safety Engineering.**

B.2.1.1 Roadway Widths - Major Highways

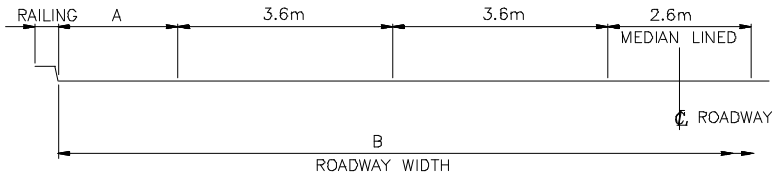


Figure B.1

Alignment	A	B
Tangential to and radius greater than or equal to 1200 m	2.0	21.0
Radius less than 1200 m	2.5	22.0

Table B.2

B.2.1.1 Roadway Widths - Major Highways (cont'd)

Length of Bridge	A (metres)
LESS THAN OR EQUAL TO 200m	AS PER TABLE B.1
GREATER THAN 200m AND LESS THAN OR EQUAL TO 300m	(TABLE B.1) - (X/100 x 0.5)*
GREATER THAN 300m	(TABLE B.1) - 0.5

* X = length of bridge - 200 m

Table B.2

B.2.1.2 Roadway Widths - Secondary Roads

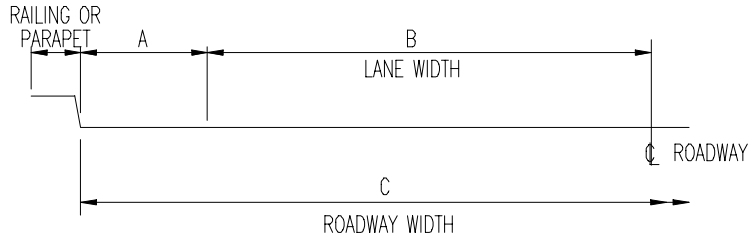


Figure B.2

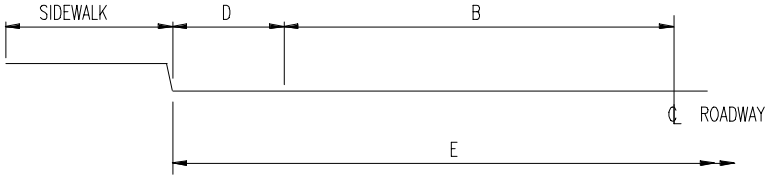


Figure B.3

CLASS OF ROADWAY	A m	B m	C m	D m	E m
MAJOR COLLECTOR	1.4	3.6	10.0	1.0	9.2
MINOR(LOCAL)	1.0	3.5	9.0	0.5	8.0
RESOURCE	1.0	3.6	9.2	N/A	N/A

Table B.3

B.2.1.2 Roadway Widths - Secondary Roads (cont'd)

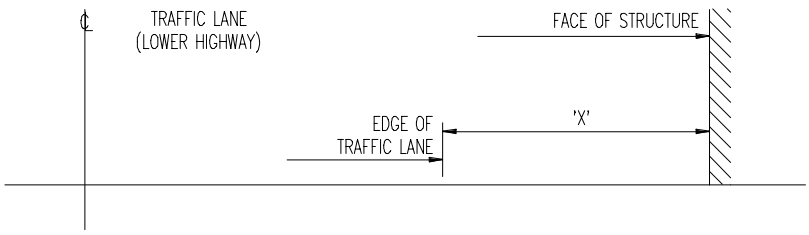
ALIGNMENT	ADDITION TO ROADWAY WIDTH
TANGENTIAL TO AND RADIUS GREATER THAN OR EQUAL TO 1200m	AS TABULATED
RADIUS LESS THAN 1200m AND GREATER THAN OR EQUAL TO 600m	0.5m
RADIUS LESS THAN 600m	1.0m

Table B.4

B.3.1 Vertical Clearances over Highways

a) Bridges 5.0 metres
b) Pedestrian Overpasses 5.5 metres
c) Traffic Sign Bridges 5.5 metres

B.3.2 Lateral Clearances for Highways



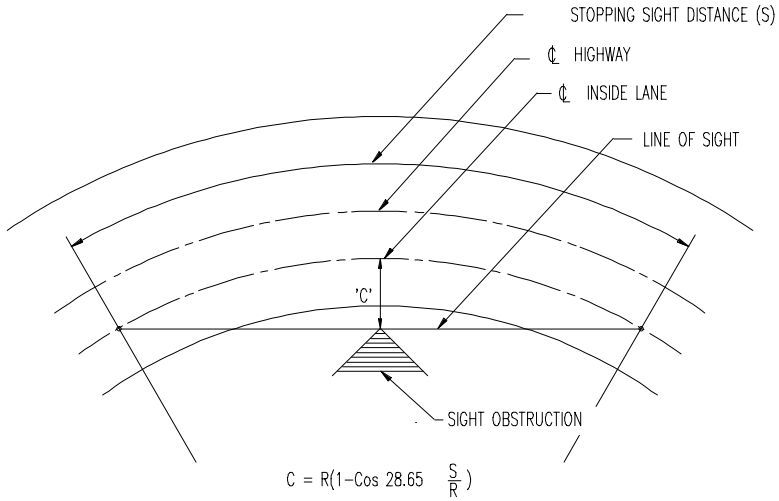
a) Lower highway tangential
x = full shoulder (1.8 metres min)

b) Lower highway on curve
'x' shall accommodate minimum stopping sight distance (SSD) as shown in **Table B.5** and modified for grade and curvature.

Design Speed Km/h	SSD m
40	45
50	65
60	85
70	110
80	140
90	190
100	220
110	245

TABLE B.5

B.3.2 Lateral Clearances for Highways (cont'd)



Stopping Sight Distance modification for grades:

Design Speed (Km/h)	Decrease for Upgrade			Increase for Downgrade		
	3%	**6%**	**9%**	**3%**	**6%**	**9%**
40	-	-	5	-	-	-
50	5	5	10	-	5	10
60	5	5	10	5	10	15
70	5	10	15	5	10	20
80	10	15	20	10	15	30
90	10	20	25	10	20	40
100	10	20	-	15	30	-
110	15	25	-	15	35	-

For design speeds of 60 Km/h to 90 Km/h and radii not more than 110% of minimum for the design speed, minimum stopping sight distances shall be increased by 5%.

Speed (Km/h)	60	70	80	90
Minimum radii (m)	135	190	250	340

Lateral clearance 'C' to the sight obstruction shall be calculated as illustrated in **Figure B.5** to arrive at a value for 'X.'

B.3.3 Clearances over Railways

i) center to center of tracks: 4.57 metres/15 ft (typical)
ii) vertical: 7.2 metres/23 ft 6 ins above the base of the rail (Federal Railways) or 6.68 meters/21 ft. 11 ins. above top of rail (Provincial Railways)
iii) horizontal: 5.50 metres/18 ft (Federal Railways) or 2.44 meters/8 ft (Provincial Railways) from the centerline of track. Federal Railways may accept less than 5.5 m when the railways are not sharing in the costs of the work. Often, due to ditch requirements, footing size and railway loading effects, clearances of 4 m is effective.

For each degree of curvature of the track, the horizontal clearance shall be increased by 50 mm each side of track.

Crash walls should be considered for any structures with substructure components within 7.65 meters/25 ft. of any track.

Continuous drainage over structure is preferred, but in no case shall deck drains be closer than six meters to the tracks unless in a closed system. Careful consideration shall be given to drainage adjacent to the track.

B.3.4 Bicycle and Pedestrian Sidewalk Width

A minimum width of 2 metres shall be used for the combined bicycle and pedestrian sidewalk.

B.3.5 Mechanically Stabilized Earth Abutment Walls

Consideration shall be given to the provision of reasonable access for the maintenance and inspection of abutment bearings.

B.4.1 Railings and Parapets

1. Vehicular traffic. Sidewalks are not provided for pedestrians

i) Full shoulders across bridge

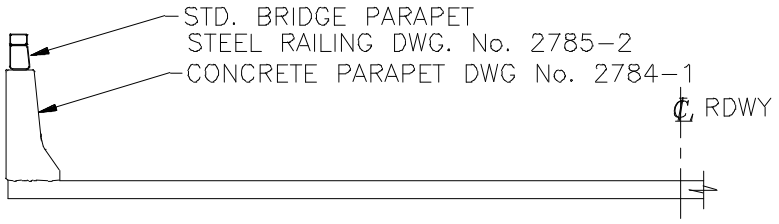


Figure B.6

2. Vehicular and pedestrian traffic

i) Urban areas. Low traffic speed (60 kph).

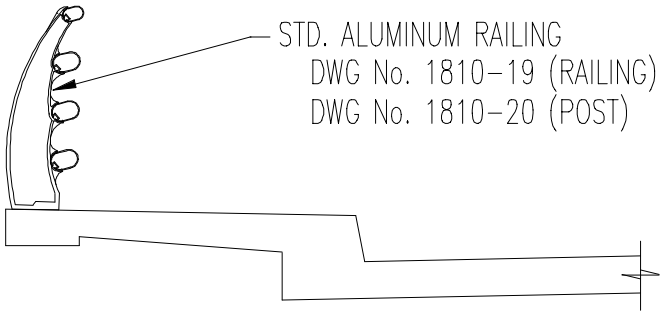
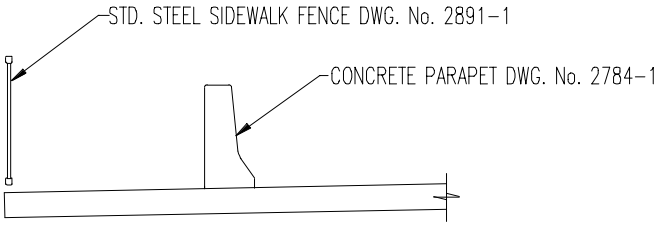


Figure B.7

ii) All areas. Highway traffic speed (60 kph and greater).



3. All parapets, railings, fences, and transition pieces shall be at right angles to the deck. Sidewalk railings shall be vertical.

B.4.2 List of Standard Drawings

Drawing No.	Title	Metric/ Imperial
1810-19	Standard Aluminum Railing, Sheet 1	Imperial
1810-20	Standard Aluminum Railing, Sheet 2	Imperial
1810-30	Standard Aluminum End Railing Arrangement	Imperial
1810-31	Standard Aluminum End Railing Casting Details	Imperial
2784-1	Standard Bridge Parapet	Metric
2784-2	Standard Bridge Parapet 810mm High Transition	Metric
2784-3	Standard Bridge End Details	Metric
2785-2	Standard Parapet Steel Railing (1995)	Metric
2891-1	Standard Steel Sidewalk Fence	Metric
2891-2	Standard Steel Bicycle Fence	Metric
2959-1	Standard Timber Railing	Metric

The following drawings are available in the “Standard Specifications for Highway Construction.

Drawing No.	Title	Metric/ Imperial
1-SP323	Precast Concrete Bullnose & Low Barrier (18”)	Imperial
2-SP323	Precast R.C. No Post Barrier (27”)	Imperial
8-SP323	Precast R.C. Transition Barrier (686, 690mm)	Metric
9-SP323	Precast R.C. Transition Barrier (690, 457mm)	Metric
10-SP323	Precast R.C. Roadside Barrier, Male (690mm)	Metric
11-SP323	Precast R.C. Roadside Barrier, Female (690mm)	Metric
12-SP323	Precast R.C. Roadside Barrier (810, 690mm)	Metric
13-SP323	Precast R.C. Median Barrier, Male (810mm)	Metric
14-SP323	Precast R.C. Median Barrier, Female (810mm)	Metric
15-SP323	Precast R.C. Pier Barrier (810mm)	Metric
16-SP323	Precast R.C. Drainage Barrier, Female (690mm)	Metric

B.4.3 Cast-in-Place Parapets

1. On bridges with one sidewalk, parapet railings shall be installed on all parapets.

   On bridges with two sidewalks, parapet railings shall be left out from all parapets.

   On bridges in remote areas, the extent of pedestrian traffic shall be investigated, and if negligible, parapet railings shall be left out.

2. On box stringer bridges, parapet reinforcing steel shall not be anchored in the 100 mm concrete overlay, unless necessitated by complex bridge geometry.

3. Parapets shall not be located on deck slabs cantilevered off box stringer bridges.

B.4.4 Extruded Barriers

Extruded concrete barriers shall not be used.

B.5.1 List of Standard Drawings

The following drawings show the geometry of the various types of prestressed concrete box stringers and "I" Girders. Each designer must satisfy the design codes relating to the concrete strength and to the number of strands and rebars used.

A) Standard Twin Cell Prestressed Concrete Box Stringers

Drawing No.			
2978-1	MK.500/8/E	&	MK.500/8/I
2978-2	MK.550/E/10°	&	MK.500/8/I/10°
2978-3	MK.550/8/E/20°	&	MK.500/8/I/20°
2978-4	MK.500/8/E/30°	&	MK.500/8/I/30°
2978-5	MK.500/10E	&	MK.500/10/I
2978-6	MK.500/10/E/10°	&	MK.500/10/I/10°
2978-7	MK.500/10/E/20°	&	MK.500/10/I/20°
2978-8	MK.500/10/E/30°	&	MK.500/10/I/30°
2978-9	MK.600/12/E	&	MK.600/12/I
2978-10	MK.600/12/E/10°	&	MK.600/12/I/10°
2978-11	MK.600/12/E/10°	&	MK.600/12/I/20°
2978-12	MK.600/12/E/30°	&	MK.600/12/I/30°
2978-13	MK.600/14/E	&	MK.600/14/I
2978-14	MK.600/14/E/10°	&	MK.600/14/I/10°
2978-15	MK.600/14/E/20°	&	MK.600/14/I/20°
2978-16	MK.600/14/E/30°	&	MK.600/14/I/30°
2978-17	MK.700/16/E	&	MK.700/16/I
2978-18	MK.700/16/E/10°	&	MK.700/16/I/10°
2978-19	MK.700/16/E/20°	&	MK.700/16/I/20°
2978-20	MK.700/16/E/30°	&	MK.700/16/I/30°
2978-21	MK.700/18/E	&	MK.700/18/I
2978-22	MK.700/18/E/10°	&	MK.700/18/I/10°
2978-23	MK.700/18/E/10°	&	MK.700/18/I/20°
2978-24	MK.700/18/E/30°	&	MK.700/18/I/30°

b) Standard Single Cell Concrete Box Stringers

Drawing No. D 205

c) Standard Prestressed concrete "I" Beams

Drawing No. D 202

B.5.2 Ends of Prestressing Strands

Two coats of an approved galvanizing paint shall be applied when the ends of prestressed box stringers and girders are eventually covered with a concrete nosing or embedded in concrete.

A minimum of 3 mm coat of thixotropic epoxy shall be applied to the ends of the box stringers and girders in accordance with the manufacturer's instructions when the ends are not embedded in concrete.

B.5.3 Debonded Prestressing Strands

Debonded prestressing strands shall not be used.

B.5.4 Non-Composite Prestressed Box Stringers

Prestressed concrete box stringers shall be designed as "non-composite." The placement of the concrete overlay shall be considered as an additional dead load and shall not be assumed to be contributing to any composite properties under live loads.

B.5.5 Maximum concrete Design Strength

The maximum concrete design strength for prestressed concrete shall not exceed 55 MPa for the standard 28 days. The maximum concrete design strength at release shall not exceed 37.5 MPa.

B.6.1 Splices in Reinforcement

1. All splices that are critical to the structure shall be indicated by the Design Engineer.

2. Splices shall be based on standard reinforcing bar lengths of 12m for 10M bars and 18m for 15M bars and greater.

3. Splicing of transverse reinforcing bars in decks shall be avoided. If such splices are unavoidable, their location shall be indicated by the Design Engineer.

B.6.2 Reinforcing at Diaphragms

a) End Diaphragms

The deck shall be supported by an end diaphragm or trimmer beam at each end. Additional reinforcing shall be placed between the longitudinal temperature reinforcing. The added reinforcing shall be **15M** bars and shall extend for a distance S/2 into the deck slab from the edge of the diaphragm where 'S' is the c/c of stringers. The bars shall have standard hook at the diaphragm end.

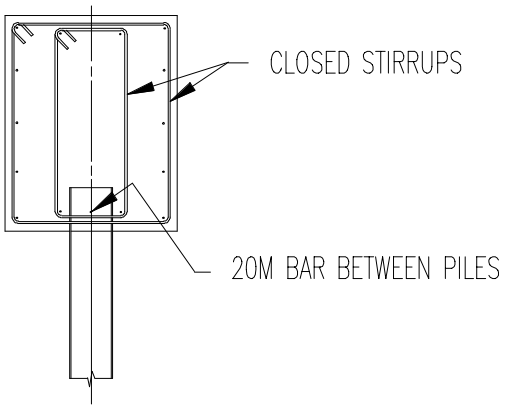
b) Intermediate Diaphragms

Where intermediate diaphragms support the slab, bars shall be added between the longitudinal reinforcing. The bars shall be **15ME** and the length shall equal 'S.'

B.6.3 Minimum Reinforcing of Flexural Members

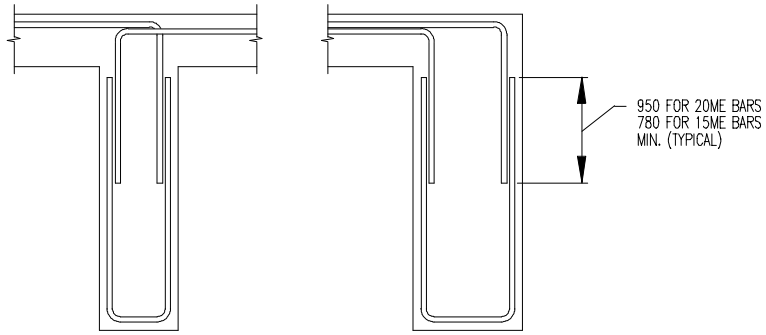
The requirements of $\mathbf{1.25M_{cr}}$ or $\mathbf{1.4/F_y}$ may be waived if the reinforcement provided at a section is at least **one-third** greater than that required by analysis.

B.6.4 Reinforcing of Pier Caps



TYPICAL PIER CAP REINFORCING

B.6.5 Typical Tie Arrangement



TYPICAL TIE ARRANGEMENT AT INTERMEDIATE AND END DIAPHRAGMS

B.6.6 Upper Limit for Yield Strength

The upper limit of 525 MPa for yield strength of Grade 400 regular billet steel bars shall be specified on drawings for members resisting seismic induced forces.

The specified value for the upper limit for yield strength of regular billet steel bars shall be verified from test samples prior to placement.

B.7.1 Concrete Surface Finishing - General

The following surface finished shall be specified on the design drawings as per Section 211.16 of the Ministry's Standard Specifications.

Surface submerged or buried	Class 1
Curbs and parapets	Class 3
Abutments	Class 2
Piers	Class 1, 2, or 3*
Bearing seats	Trowelled finish**
Top of deck and sidewalks	Textured finish
Underside of deck	Class 1 or better ***

The class of finish on concrete girders shall be shown on the drawings.

* Depends on the degree of exposure - see Section 211.16 of the Ministry's Standard specifications.
** Tolerance 2mm
*** Overpasses, underpasses and railway overheads shall be given special consideration.

B.7.2 Concrete finish on Abutments and Retaining Walls

All exposed surfaces of abutments and retaining walls shall be given a Class 2 finish as per Section 211 of the Standard Specifications for Highway Construction.

At the discretion of the Design Engineer and subject to the approval of the Senior Bridge Design Engineer, an architectural finish may be called for if the structure satisfies some of the following criteria.

a) Exposed structure height exceeds 3.0 m and width exceeds 9.0 m.
b) The structure is clearly visible to the travelling public.
c) The structure is in a developed or landscaped surrounding.
d) Overpasses, underpasses and railway overheads with no slope paving.
e) River crossings with substantial recreational marine traffic.
f) Pedestrian overpasses where school children constitute a significant potion of the pedestrian traffic.
g) Multi-use crossings serving a combination of marine, vehicular and pedestrian traffic.
h) Earth retaining structures adjacent to, and in line with abutments of structures specified above.

B.7.3 Requirements for Concrete Mixes

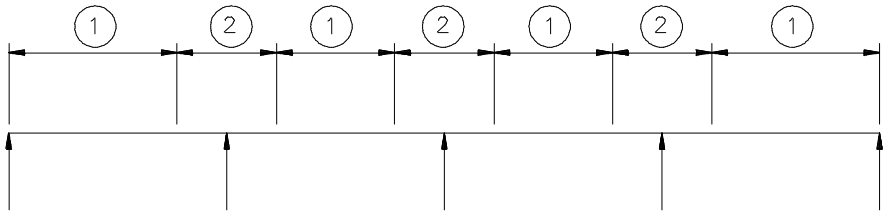
Concrete mixes shall meet the requirements given in the following table:

	Min. compr. strength at 28 days	Max nominal size of aggregate mm	Air content %	Slump mm	Max w/c ratio by mass
Deck slab, parapet, approach slab, median	35 MPa	28	5 ± 1	30 ± 20	0.38
Piers & Abutments	30 MPa	29	5 ± 1	50 ± 20	0.45
Deck Overlays	35 MPa	12	6 ± 1	20 ± 10	0.35
Footings	30 MPa	28	5 ± 1	50 ± 20	0.45
Working Floors	20 MPa	28	6 ± 1	50 ± 20	0.45
Filling Pipe Piles	30 MPa	28	5 ± 1	50 ± 20	0.50
Keyways between Box Stringers	35 MPa	12	6 ± 1	20 ± 10	0.35

B.8.1 Deck Slabs - Concrete Placing

For continuous structures, a placement sequence as illustrated shall be shown on the drawings. The concrete in the positive moment zones shall be placed first, followed by placement of the concrete in the negative moment zones.

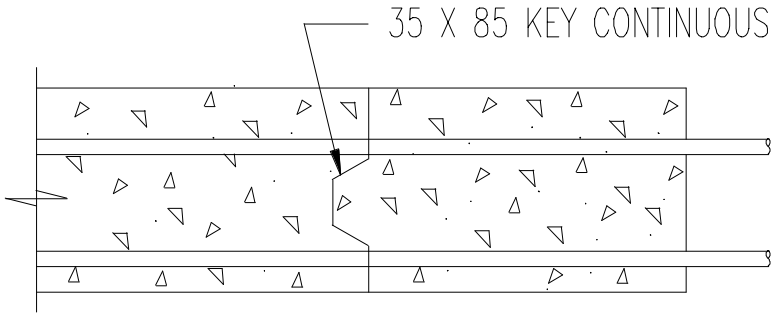
The following note shall be placed on the drawing: "Concrete in zone 1 shall be 24 hours old before concrete in zone 2 is placed."



For simply supported spans, the deck concrete shall preferably be placed in one full span operation.

Several factors limit the quantity of concrete which can be placed in one continuous operation. Prior to completing the contract documents, the **Bridge Construction Manager** shall be consulted if a continuous placement exceeds **200 cubic metres**. The **Bridge Construction Manager** shall also be consulted where a bridge deck is four lanes or more in width.

The construction joint between concrete placements shall be as shown below.



B.8.2 Deck Heating

Heating bridge decks has been determined to be inoperable by research and practice.

Its use has therefore been totally discontinued.

B.8.3 Deck Cover

A minimum cover of 70 mm shall be used for the top reinforcing of concrete decks. A cover of 40 mm shall be used for the bottom reinforcing of concrete decks.

B.8.4 Cover At Soffit - Outer Edges of Deck

The concrete cover to the soffit at the outer edges of the deck shall be increased to 50 mm to accommodate the 12 mm drainage V-groove.

B.8.5 Continuous Decks

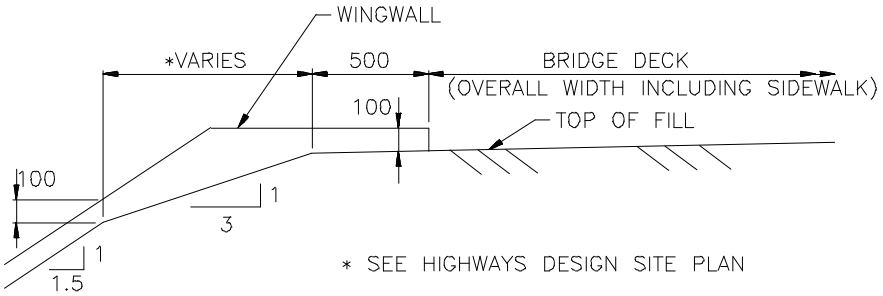
In order to minimize the number of deck joints, multiple span bridges shall be designed so that the deck is continuous when the foundation conditions are favourable.

B.9.1 Minimum Thickness of Ballast Walls

The minimum thickness of ballast walls shall be **350 mm**.

B.9.2 Approach Fill Widths at Abutments

The width of the approach fill at the back of the ballast wall shall be in accordance with the sketch shown below:



B.10.1 Prefabrication Meeting

1. **General**

Prior to the commencement of fabrication, the Bridge Construction Manager shall be responsible for arranging a meeting between Ministry and Fabricator personnel for the purpose of discussing the fabrication process.

2. **Attendees**

i. The Welding Engineer	Fabricator
ii. The Shop Foreman	Fabricator
iii. The Welding Supervisors	Fabricator
iv. The Project Manager	
v. The Bridge Construction Manager or his representative	Ministry of Transportation and Highways
vi. The Supervising Design Engineer or his representative	Ministry of Transportation and Highways
vii. The Plan and Erection Engineer	Ministry of Transportation and Highways

3. **Suggested Topics**

i. Base Metal

mill certificates
notch toughness
tests for laminations
other requirements

ii. Filler Metal and Shields

type
storage facilities

iii. Design

The design engineer shall provide information on the critical areas (including details and welds) of the work.

iv. Fabricator

a) personnel to be used on the work
b) operator certification
c) equipment
d) work periods, double shifts, etc.

B.10.1 Prefabrication Meeting (cont'd)

v. Fabrication

a) shop drawings
b) welding processes
c) special provisions
d) welding procedures
e) assembly and welding sequence
f) weld quality
g) tolerances

vi. Inspection

a) processes
b) access to the work
c) acceptance standards

vii. Storage of completed weldments

viii. Transportation of weldments

ix. Erection

x. Painting

xi. Payment

4. **Report**

Minutes of the meeting shall be prepared by the Bridge Construction Manager and filed in the correspondence file.

B.10.2 Material Sizes and Availability

1. Limitation of plate size and thickness shall be according to Section 1A of "Algoma Steel Standards and Specifications."

2. A trim allowance of 9mm to 12mm around the perimeter of the plate shall be accounted dfor in the sizing of plates.

3. When notch tough steels (WT and AT) are used, category 3 shall be specified for all locations within British Columbia.

4. Plates and welded wide flanged shapes (WWF) are available in both imperial and metric sizes. Rolled shapes are available only in imperial sizes. Metric sizes included in steel handbooks are sosft conversions of the imperial equivalents.

B.10.2 Material Sizes and Availability (cont'd)

5. Grade 260W shall not be used in bridges. Grade of steel used in Bridge Construction shall preferably be based on their availability as listed in Item 7 of this standard.

6. The following sections and grades of steel are more readily available than others and their use is recommended wherever possible.

a)	Angles and channels	300 W
b)	Hollow staructural sections	350 W
c)	H.P. Sections	300 W
d)	Plate	300 W & 350 AT
e)	Structural tees	300 W
f)	Welded reduced wide flange shapes	350 AT
g)	Welded wide flange shapes	350 AT
h)	Wide flange shapes	300 W
i)	Anchor bolts	300W

B.10.3 Material Sizes and Availability

Coil steel shall not be used.

B.10.4 High Strength bolts

High strength bolts shall conform to ASTM Standards A-325. The category of bolts to be used are as follows:

1) **For W and WT Steel** - **ASTM A-325 Type 1 Bolts, nuts and washers galvanized in accordance to ASTM A-153, Table 1.**

2) **For AT Steel** - **ASTM A-325 Type 3 Bolts**

3) **A-490 Bolts shall not be used**

B.10.5 Fatigue in Riveted Connections

The stress **Category "D"** shall be used in determining the allowable range of stress in tension or reversal for base metal at net sections of riveted connections.

B.10.6 Maximum Unreinforced Haunch Height

The maximum unreinforced haunch height shall be 75 mm over the negative moment areas of continuous steel girders when shear connectors are not installed.

B.11.1 Diaphragms

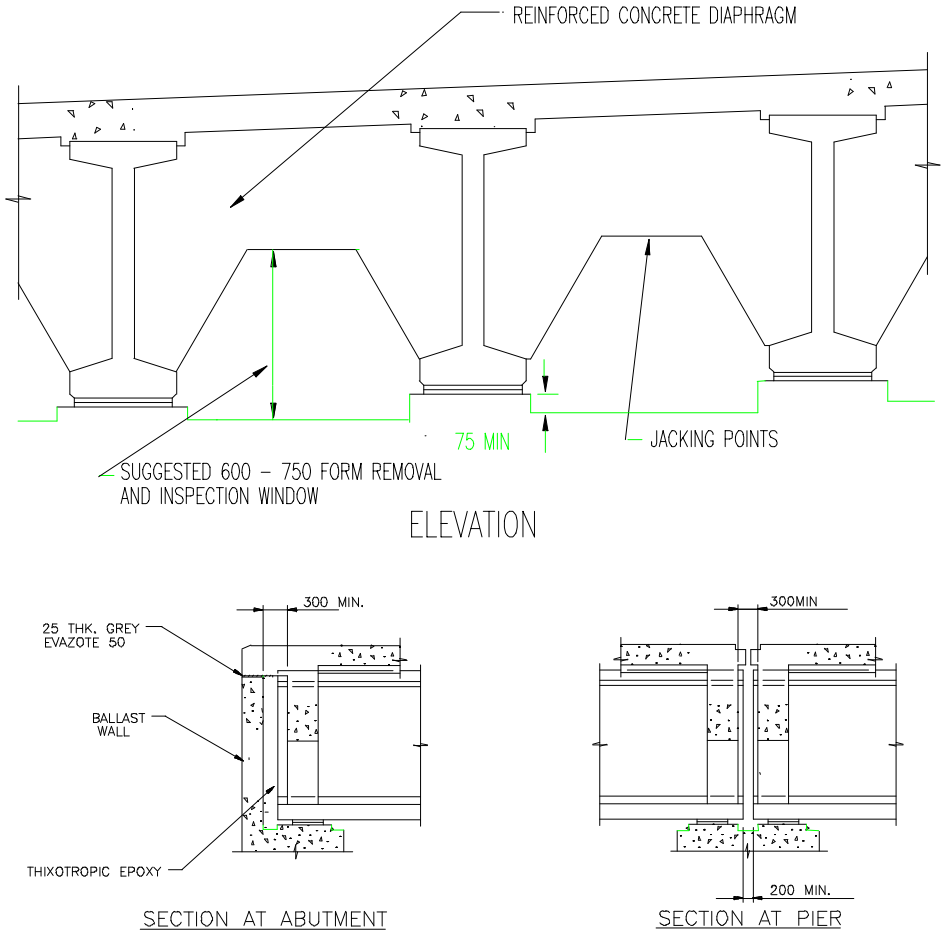
End diaphragms for prestressed “I” Beam bridge spans shall be parallel to the ballast walls and shall be designed to facilitate jacking as indicted in Figure B.11.

Intermediate diaphragms shall be at right angles to the deck.

Shear keys shall be provided if required for lateral loads.

Ends of stringers shall be given a minimum 3 mm coat of thixotropic epoxy. Manufacturers instructions shall be strictly adhered to.

Provisions for maintenance inspection access shall be made between the diaphragms and ballast walls at abutments and between diaphragms at piers.



B.11

B.11.2 Minimum Thickness of Diaphragms

The minimum thickness of diaphragms shall be **350 mm.**

B.11.3 Steel Diaphragms

Intermediate steel diaphragms shall be used on precast concrete bridges which are not skewed.

B.11.4 Jacking

Bridges shall be designed with provisions for jacking during future maintenance operations and the proposed locations for jacking shall be indicated on the contract drawings.

B.12.1 "Finger" Plate Deck Expansion Joint

Expansion joints shall be designed as "finger" plate deck joints when the total temperature movement is in excess of 100 mm.

The "finger" plate deck expansion joint shall have a drainage trough beneath, which is offset, and all steelwork shall be galvanized after fabrication. A hose connection shall be provided to allow easy attachment for flushing and cleaning of the drainage trough for future maintenance.

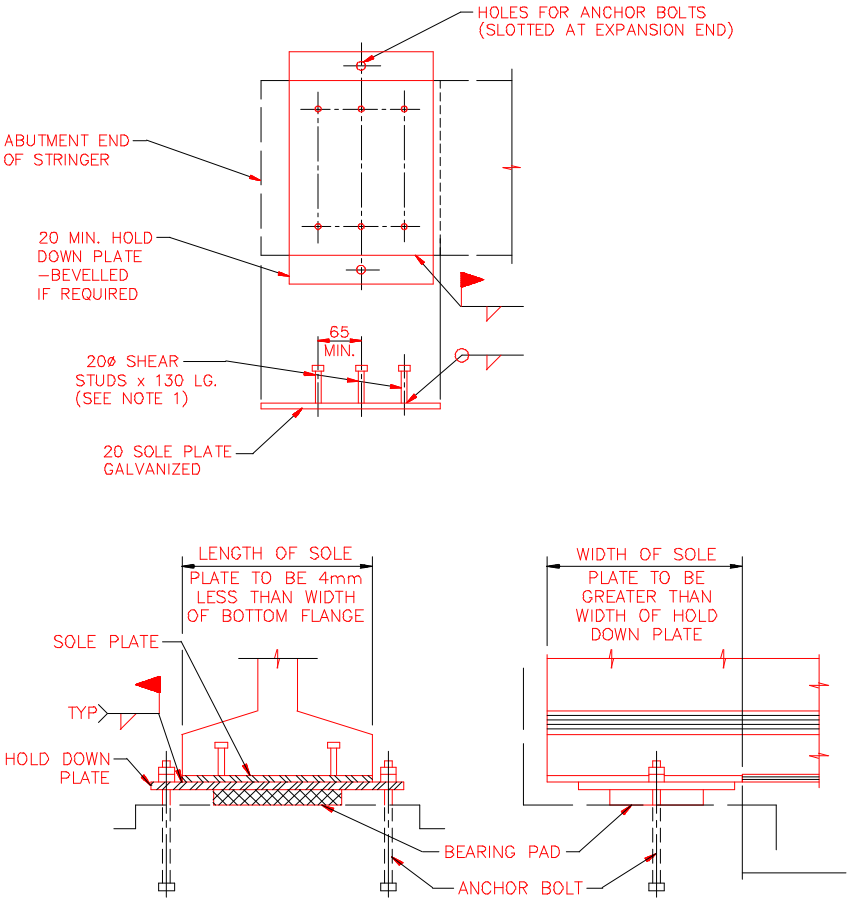
B.13.1 Bearing Details

The recommended details at bearings for non-seismic loadings shall be as shown below.

The 20 mm sole plate embedded in the I beam shall be field welded to the hold-down plate.

The hold down plate shall be beveled to suit grade if required.

The holes for anchor bolts in hold-down plate shall be slotted at expansion ends.



NOTES:

1. LENGTH OF STUDS TO BE ADJUSTED SUCH THAT THE STUD HEAD LIES BETWEEN LAYERS OF STRANDS.

2. GRIND OFF GALVANIZING ON EDGES OF SOLE PLATE AND TOP OF HOLD DOWN PLATE TO ACCOMMODATE WELDING. PAINT WELDS AND EXPOSED STEEL WITH AN APPROVED GALVANIZING AGENT AFTER ERECTION.

B.13.2 Elastomeric Bearings

Unreinforced elastomeric bearings can be cut from 20 mm thick precured stock.

Steel reinforced elastomeric bearings shall have at least two steel reinforcing plates and the cover of elastomer for the top and bottom steel reinforcing plates shall be 5 mm.

Elastomeric bearings shall be used whenever possible for I-Girders and Box Stringers.

The design of unreinforced and steel reinforced elastomeric bearings for compressive deformation shall account for the different deformation responses (when subjected to the same compressive force) of the following:

- the internal layers of elastomer in steel reinforced bearings
- the cover layer of elastomer in steel reinforced bearings
- plain unreinforced bearings.

The Designer may use the Beta Factor described in Dupont's Catalogue "Engineering Properties of Neoprene Bridge Bearings" or another suitable method.

B.13.3 Tabulation of Design Loads and Bearing Pressures

The tabulation of permanent vertical load, total vertical load and bearing pressures at serviceability limit states design shall be shown on the drawing for each bearing.

B.14.1 Scuppers

Scuppers may be used for surface drainage of decks on concrete box stringer spans.

B.14.2 Drainage of Surfaces Adjacent to Bridge Bearing Seats

Concrete surfaces between bridge bearing seats shall be sloped.

B.14.3 Drainage Course Material

The gradation of drainage course material shall be as follows:

Sieve Size (mm)	Passing Per Nominal Maximum Size
40	100
20	0 - 100
10	0

B.15.1 Waterproofing Membrane and Asphalt Overlay

When an asphalt pavement overlay is specified for new bridge decks, the concrete cover shall be reduced to 60 mm for the top reinforcing steel, and weep holes shall be provided. The top surfaces of prestressed concrete box stringers and concrete decks shall be protected with an approved waterproofing membrane, applied in accordance with the manufacturer's instructions. An asphalt overlay of 90 mm shall be placed in two lifts of 50 mm and 40 mm.

B.16.1 Dowels

Prestressed Concrete Box Stringers

a) Dowel Holes (Fixed)

To be filled with non-metallic, non-shrink grout with minimum compressive strength of 25 MPa at 7 days.

b) Dowel Holes (Expansion)

To be filled with Styrofoam granules and ensure there is space at top of dowel for vertical movement.

B.17.1 Shear Keys

Shear keys between adjacent boxes shall be filled with 12 mm aggregate concrete having a minimum compressive strength of 35 MPa at 28 days.

CHAPTER C
DRAFTING STANDARDS

C.1.1 Scope

The **Drafting Standards** shall be subject to **periodic review** and **amendments.**

C.1.2 Dimensioning

1. The method of denoting measurement shall be consistent on all drawings.

2. In general;

   i. Elevations and Stations

   shall be shown in meters, using a decimal point as a division between metres and millimetres, thus:

   a) elevation: 100.040
   b) station: 80 + 12.320

   ii. All other dimensions shall be shown in millimetres using a discernible gap as a division between metres and millimetres, thus:

   a) 12,415 or 1080
      or 150 x 180 x 12 angle
      or 25 dia. Bolt
      or 10M reinforcing bar
      or 6 weld.

3. The only exceptions to the general rule shall be:

   i. Contours shall be shown thus: 280 or 98

   ii. Elevations on the profile scale shall be shown thus: 105, 110, 115, etc. And stations on the profile scale shall be shown thus: 12 + 00, 12 + 25, etc.

C.1.3 Geometrics - Spiral to Curve

L_S = Length of Spiral

S_e = Superelevation

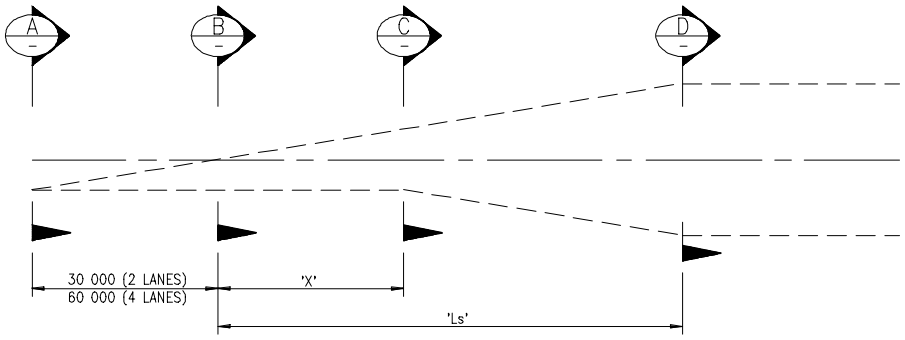
S_e/L_S = Rate of change in superelevations/metre

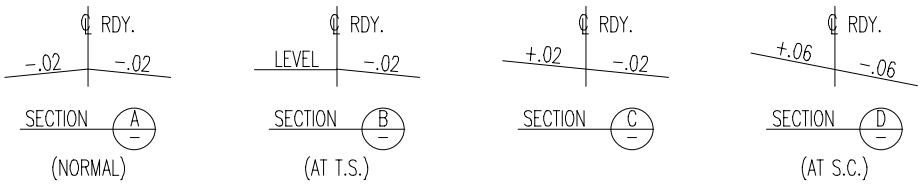
$(0.02 \times L_S)/S_e$ - Distance from TS

EXAMPLE

L_S = 70 m
S_e = 0.06

Rate of change in superelevation = 0.06/70 = 0.000857/metre
x = (0.02 x 70)/0.06 = 23.33 metres.





C.2.1 Standard Cover Sheet

PROVINCE OF BRITISH COLUMBIA

MINISTRY OF TRANSPORTATION
AND HIGHWAYS
BRIDGE PROJECT

No. XXXXX
JOHN DOE BRIDGE
HIGHWAY No. or JOHN DOE ROAD
CONTRACT No. X - SUPERSTRUCTURE

C.2.2 Standard Title Block

HIGHWAY DISTRICT
HIGHWAY No. or ROAD

JOHN DOE BRIDGE
TITLE OF DRAWING

C.2.3 Preliminary Drawings

Preliminary Layout drawings are intended:

1. To acquaint Ministry officials with general details of the proposed bridge.
2. To obtain approval of the proposed bridge from the Director, Bridge Engineering and the Senior Bridge Design Engineer.
3. To identify and solve general problems connected with the project prior to final design commencing.

C.2.3 Preliminary Drawings (cont'd)

A Preliminary Layout should be made on a Xerox copy of the bridge site plan printed on tracing paper. A print of reasonable quality may be obtained by using a black "Superball" pen or a soft pencil.

The drawing should be generally pictorial with minimum detail. For example, show no more than one P.C. beam in cross-section, use a short length of railing and indicate rip rap in perimeter with minimum illustration. Printing should not be of contract drawing quality.

The layout should contain the following information:

a) Approach fill details including paving, etc.
b) Roadway, sidewalk, curb widths
c) Roadway alignment (vertical, horizontal)
d) Right-of-way
e) Site preparation information
f) Channel and rip rap information
g) Location of substructure units
h) Deck and site drainage details
i) Retaining walls
j) Clearances
k) Approach curb details
l) Railings

C.2.4 Drawings and Details for Bridge Contracts

1. <u>Drawings</u>

a) Title Page

b) Site Plan

c) General Arrangement

d) Railway Layout (not part of contract documents)

e) General Site Preparation Approach Fills, Channelization Rip Rap (if part of bridge contract and if too extensive for General Arrangement)

f) Abutments

g) Piers and Bents

h) Stringers

i) Deck

j) Fences

C.2.4 Drawings and Details for Bridge Contracts (cont'd)

k) Expansion Joints

l) Slope Paving

m) Miscellaneous:
   i) Drains
   ii) Anchor bolt blockouts
   iii) Bearings (steel and elastomeric)

n) Borehole Data

2. <u>Site Plan</u>

The drawing should show the site as it will be at the time of arrival of the Contractor. The stations should proceed left to right.

a) Scale 1:250

b) Plan

c) Profile on centreline of highway as working line with vertical and horizontal scales at 1:250

d) Geometry of new highway

e) Profile of new highway

f) Working lines

g) Existing structure, roads, ditches, drains

h) Existing fill placement including surcharge

i) Existing rip rap

j) Key Map

k) List of drawings (including reference drawings and indicate "revision letter" of Standard Drawings)

l) Soil test hole locations

m) Elevations at top of fill

n) Stations at termination of fills

C.2.4 Drawings and Details for Bridge Contracts (cont'd)

o) Extreme high water

p) Normal high water

q) Normal water level

r) Direction of stream or river flow

s) Direction of highway

t) North sign

u) Right-of-way boundaries

v) Location of rails and elevation at base

w) General notes:
   i) Survey by
   ii) Bench-mark
   iii) Datum

3. <u>General Arrangement</u>

a) Plan (deck and layout)

b) Section: split on centreline of highway and face of bridge

c) Section west abutment

d) Section piers (typical)

e) Stations at face of ballast wall

f) Width of roadway, sidewalks

g) Offsets and details of bridge end flares

h) Span dimensions

i) Rip rap details

j) Fill details (slopes)

k) Extent of contract

l) Fixed, expansion bearings

C.2.4 Drawings and Details for Bridge Contracts (cont'd)

m) General notes:
   i) Design specifications
   ii) Loading

n) Deck joints

o) Structural component description

p) Utilities

q) North sign

r) Highway direction

s) Superstructure, substructure, anchor bolt layout

t) Clearance diagram - overheads, overpasses

u) Detour Details (unless separate drawing)

4. <u>Abutments</u>

a) Plan

b) Elevation

c) Section on centre

d) Section on wing wall

e) General dimensions, reinforcement

f) Work points, working lines

g) Anchor bolt location relative to abutment (pictorially)

h) Bearing seat and roadway elevations

i) Note of bridge seat elevations to be confirmed, if not known

j) Note on anchor bolt blockouts

k) Blockout setting detail

l) Bridge number detail

m) Quantities

C.2.4 Drawings and Details for Bridge Contracts (cont'd)

n) Joints

o) Rock profiles
p) Pile details
q) Working floor

r) Notes:

i) Concrete
ii) Exposed edges
iii) Drainage course
iv) Reinforcing specification
v) Cover
vi) Splicing
vii) Footing elevation revision
viii) Working floor
ix) Fill, ground lines

5. <u>Piers</u>

a) Plan on bridge seats
- locate anchors pictorially

b) Elevation

c) Section on stem

d) Plan on footing

e) Ground, fill lines

f) Seat elevations

g) Footing elevations

h) Pile Details

i) Quantities

j) Rock profiles

k) Cofferdam details

l) Nosing plates (location)

m) Reinforcing diagram if required

C.2.4 Drawings and Details for Bridge Contracts (cont'd)

6. <u>Superstructure, Beams, Stringers, Girders</u>

I. Steelwork

a) Linear plan on superstructure

b) Linear elevation

c) Large scale stringer elevation

d) Large scale plan on flange

e) Splice details

f) Vertical and horizontal bracing details

g) Stiffener details

h) Special details

i) Notes:

i) Specification
ii) Loading
iii) Structural steel specification
iv) Holes
v) Bolts
vi) Paint
vii) Anchor Bolts
viii) Drains

II Concrete

a) Plan on superstructure

b) Elevation on girders

c. Plan on beam

d. Elevation

e. Sectional plan

f. Cross-sections
g. Sole plate details, etc.

C.2.4 Drawings and Details for Bridge Contracts (cont'd)

h. Notes:
- i) Strands
- ii) Concrete
- iii) Reinforcing
- iv) Cores
- v) Chamfers
- vi) Lifting devices
- vii) Paint ends of stringers
- viii) Sole plate material

7. <u>Deck</u>

Sheet 1

a) Elevation (outer railings, traffic and pedestrian)

b) Plan

c) Elevation (inner railings)

d) Cross-section

e) Anchor post setting (drains, haunches)

f) Notes:

- i) Concrete
- ii) Placing
- iii) Exposed edges
- iv) Reinforcing
- v) Cover
- vi) Splicing
- vii) Curbs, sidewalks placing
- viii) Deflection, camber accommodation
- ix) Underside posts protection

g) Quantities

Sheet II (if required)

a) Part plan

b) Section of diaphragms and cross bracing

End post details

Note: Sections should be in the direction of chainage.

C.2.4 Drawings and Details for Bridge Contracts (cont'd)

8. Slope paving

a) Plan
b) Section
c) Details
d) Quantities
e) Notes

9. Miscellaneous Details

a) Drains
b) Anchor blockout
c) Bearings
d) Fixed and expansion deck joints, joint waterproofing, rail splices, intermediate steel diaphragms and transition barriers.

10. Stress Sheets

The following combinations of the **moment and shear diagrams** for the Ultimate Limit States design of the continuous or semi-continuous (where applicable) structures shall be shown as follows:

a) A
b) B
c) (B + C)
d) (B + C + D)
e) (B + C + D + E)
f) (B + C + D + E + F)

where A = Factored Resistance
B = Factored non-composite dead load moment and shear
C = Factored composite dead load moment and shear
D = Factored live load moment and shear
E = Factored dynamic load allowance for moment and shear
F = Factored moments and shears from shrinkage, creep, temperature, prestress, etc. (where applicable)

Tabulations of the load factors and distribution factors shall also be included. The method of obtaining the distribution factor shall be indicated (e.g. CAN/CSA Clause 5.3.2.2 or grillage analysis).

C.2.4 Drawings and Details for Bridge Contracts (cont'd)

11. "Summary Logs" and "Plan & Geotechnical Profile" Drawings - (supplied by Geotechnical Engineering Branch)

a. Soil classification
b. Blow count
c. Recovery
d. Gradation

C.2.5 General Notes on Drawings

SITE PLAN

NOTES

1. SURVEY BY:

2. DATUM: GEODETIC.

3. DATUM: ASSUMED.

4. BENCH MARK:

5. FOR BOREHOLE DATA SEE DWG. NO. XXXX-XX.

GENERAL ARRANGEMENT

NOTES

1. DESIGN SPECIFICATION:
   - CAN/CSA-S6-88.
   - ATC-6 SEISMIC DESIGN GUIDELINES

2. DESIGN LOADS:
   - LIVE LOAD: CS-600
   - DEAD LOAD: Includes 1.2kN/m^2 Allowance for Future 50mm Wearing Surface.
   - EARTHQUAKE: A = 0.XX
   - DESIGN TEMP.RANGE:Max ?°C & Min-?°C
   - RAINFALL: ?mm/15 Minutes
   - WIND LOAD: 1/100 Year Reference=?kPa
   - GROUND SNOW LOAD:?kPa (If Applicable)

C.2.5 General Notes on Drawings (cont'd)

SUBSTRUCTURE

NOTES

1. ALL CONCRETE TO HAVE A MINIMUM COMPRESSIVE STRENGTH OF 30 MPa AT 28 DAYS EXCEPT AS NOTED.

2. ALL EXPOSED EDGES OF CONCRETE TO BE CHAMFERED 20 UNLESS NOTED OTHERWISE.

3. ALL REINFORCING STEEL TO CONFORM TO CSA SPECIFICATION G30.18-M, GRADE 400R. (Specify Upper Limit of F_y for Seismic Design)

4. ALL REINFORCING STEEL TO HAVE 60 COVER UNLESS NOTED OTHERWISE.

?. ALL LAPS OF REINFORCING FOR SPLICES SHALL BE AS FOLLOWS UNLESS NOTED OTHERWISE:

	UNCOATED	UNCOATED TOP BARS*	EPOXY COATED
10M			
15M			
20M			
25M			
30M			
35M			

? FOOTINGS TO BE CARRIED DOWN TO ELEVATIONS SHOWN OR TO ELEVATIONS AS MAY BE ORDERED BY THE MINISTRY REPRESENTATIVE.

? STEEL PIPE PILES TO CONFORM TO A.S.T.M. SPECIFICATION A252 GRADE 2 AND FABRICATED WITH FULL PENETRATION BUTT WELDS.

? H-PILES TO CONFORM TO C.S.A. SPECIFICATION G40.21M GRADE 300W.

? H-PILES TO CONFORM TO C.S.A. SPECIFICATION G40.21M GRADE 300W.

? PILES TO BE INSTALLED TO ELEVATIONS SHOWN OR TO SUCH ELEVATIONS AS MAY BE ORDERED BY THE MINISTRY REPRESENTATIVE.

? A CONTINUOUS COURSE OF COARSE GRAVEL, AS SHOWN, TO BE PLACED AT BACK OF ABUTMENTS.

C.2.5 General Notes on Drawings (cont'd)

? FOR PILE SPLICE DETAIL, SEE DRAWING NO. XXXX-X.

? MECHANICAL COUPLERS SHALL DEVELOP T LEAST 125% OF THE SPECIFIED YIELD STRENGTH OF THE BAR.

* Horizontal reinforcement with more than 300 mm concrete below bars.

STEELWORK

NOTES

1. DESIGN SPECIFICATIONS CAN/C.S.A.-S6-88

2. LIVE LOAD CS-600

3. ALL STEELWORK TO CONFORM TO C.S.A. SPECIFICATION CAN3-G40.21M GRADE AS FOLLOWS:

?. BOLTS TO CONFORM TO ASTM A-325 TYPE 1. BOLTS, NUTS AND WASHERS TO BE GALVANIZED IN ACCORDANCE WITH C.S.A. SPECIFICATION G164 TABLE 1.

? BOLTS TO CONFORM TO ASTM A-325 TYPE 3.

? FIELD CONNECTIONS - M22 (7/8" dia.) BOLTS, EXCEPT AS NOTED.

? OPEN HOLES 24 dia., EXCEPT AS NOTED.

? STEELWORK TO BE GALVANIZED AS NOTED AFTER FABRICATION. GALVANIZING TO BE IN ACCORDANCE WITH C.S.A. SPECIFICATION G164 TABLE 1.

C.2.5 General Notes on Drawings (cont'd)

SUPERSTRUCTURE - BOX STRINGERS

NOTES

1. ALL CONCRETE TO HAVE A MINIMUM COMPRESSIVE STRENGTH OF 30 MPa AT 28 DAYS EXCEPT AS NOTED.

2. ALL EXPOSED EDGES OF CONCRETE TO BE CHAMFERED 20 UNLESS NOTED OTHERWISE.

3. ALL REINFORCING STEEL TO CONFORM TO CSA SPECIFICATION G30.18-M, GRADE 400 R.

4. ALL REINFORCING STEEL TO HAVE 50 COVER UNLESS NOTED OTHERWISE.

? ALL REINFORCING MARKED "ME" ARE COATED WITH PRIMER AND EPOXY.
? ALL LAPS OF REINFORCING BARS FOR SPLICES SHALL BE AS FOLLOWS UNLESS NOTED OTHERWISE:

	UNCOATED	UNCOATED TOP BARS*	EPOXY COATED
10M			
15M			
20M			
25M			
30M			
35M			

? PARAPETS TO BE FORMED AND CONCRETE PLACED AFTER ROADWAY SLAB HAS ATTAINED A MINIMUM COMPRESSIVE STRENGTH OF 15 MPa.
? SIDEWALKS TO BE FORMED AND CONCRETE PLACED AFTER ROADWAY SLAB HAS ATTAINED A MINIMUM COMPRESSIVE STRENGTH OF 15 MPa.
? SCREEDS FOR DECK CONCRETE SHALL BE SET TO GIVE A UNIFORM GRADE FROM END TO END OF THE BRIDGE AND TO ACCOMMODATE HOGGING OF THE STRINGERS WHICH IS TO BE MEASURED IN THE FIELD.
? SHEAR KEYS BETWEEN ADJACENT BOXES SHALL BE FILLED WITH 12mm AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 35 Mpa AT 28 DAYS.
? DOWELS TO BE ENCASED IN A PLASTIC SLEEVE, PROJECTING 25 ABOVE TOP OF DOWEL AND COVERED AT THE TOP. BOTTOM OF SLEEVE TO EXTEND TO TOP OF BEARING PAD.

* Horizontal reinforcement with more than 300 mm concrete below bars.

C.2.5 General Notes on Drawings (cont'd)

DECK - GIRDER SPANS

NOTES

1. ALL CONCRETE TO HAVE A MINIMUM COMPRESSIVE STRENGTH OF 35 MPa AT 28 DAYS EXCEPT AS NOTED.
2. ALL EXPOSED EDGES OF CONCRETE TO BE CHAMFERED 20 UNLESS NOTED OTHERWISE.
3. ALL REINFORCING STEEL TO CONFORM TO CSA SPECIFICATION G30.18-M, GRADE 400R.
4. ALL REINFORCING STEEL TO HAVE 50 COVER UNLESS NOTED OTHERWISE.
5. LATERAL STABILITY OF EXTERIOR GIRDERS WITH TEMPORARY OVERHANGS FOR FORMWORK TO BE CONFIRMED FOR CONSTRUCTION LOADS.

? ALL REINFORCING MARKED "ME" ARE COATED WITH PRIMER AND EPOXY.

? ALL LAPS OF REINFORCING BARS FOR SPLICES SHALL BE AS FOLLOWS UNLESS NOTED OTHERWISE:

	UNCOATED	UNCOATED TOP BARS*	EPOXY COATED
10M			
15M			
20M			
25M			
30M			
35M			

? SPLICING OF TRANSVERSE BARS IS NOT PERMITTED. LONGITUDINAL BARS MAY BE SPLICED; SPLICES ARE TO BE STAGGERED SO THAT NOT MORE THAN EVERY THIRD BAR IS SPLICED AT ANY CROSS SECTION OF THE DECK.

? SPLICES TO BE STAGGERED SO THAT NOT MORE THAN EVERY THIRD BAR IS SPLICED AT ANY SECTION OF THE DECK. FOR TRANSVERSE BAR SPLICES, SEE DETAIL DRAWING NO. XXXX-X.

? PARAPETS TO BE FORMED AND CONCRETE PLACED AFTER ROADWAY SLAB HAS ATTAINED A MINIMUM COMPRESSIVE STRENGTH OF 15 MPa.

? DEFLECTION AND DIFFERENCE IN CAMBER WILL BE ACCOMMODATED BY DECK SCREED ELEVATIONS SUPPLIED BY THE MINISTRY REPRESENTATIVE. HAUNCH HEIGHTS WILL VARY AS REQUIRED TO MAINTAIN A CONSTANT DECK SLAB THICKNESS BETWEEN STRINGERS.

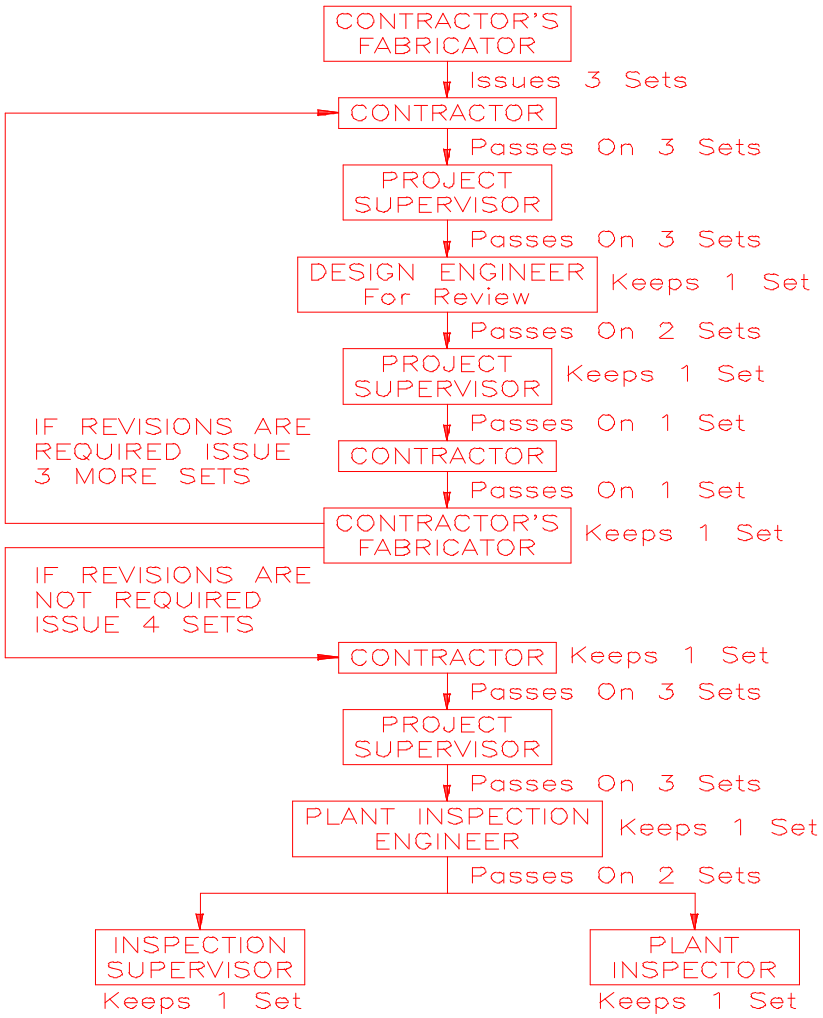
? CONCRETE FOR EACH DECK SECTION TO BE PLACED IN ONE CONTINUOUS OPERATION.

? FOR ELECTRICAL DETAILS FOR LIGHTING, SEE DRAWING NO. XXXX-X.

* Horizontal reinforcement with more than 300 mm concrete below bars.

C.2.6 Shop Drawings

The Contractor shall submit three sets of shop drawings to the Project Supervisor. The Project Supervisor shall forward three sets to the Design Engineer, who will review the drawings for general compliance with the contract requirements. If no exceptions are taken to the drawings, the Design Engineer shall return two sets to the Project Supervisor, who shall return one set of the reviewed drawings to the Contractor and request for an additional three sets of the reviewed drawings. The Project Supervisor shall subsequently forward three sets of the reviewed drawings to the Plant Inspection and Installation Engineer.



C.2.7 Revision to Contract Drawings

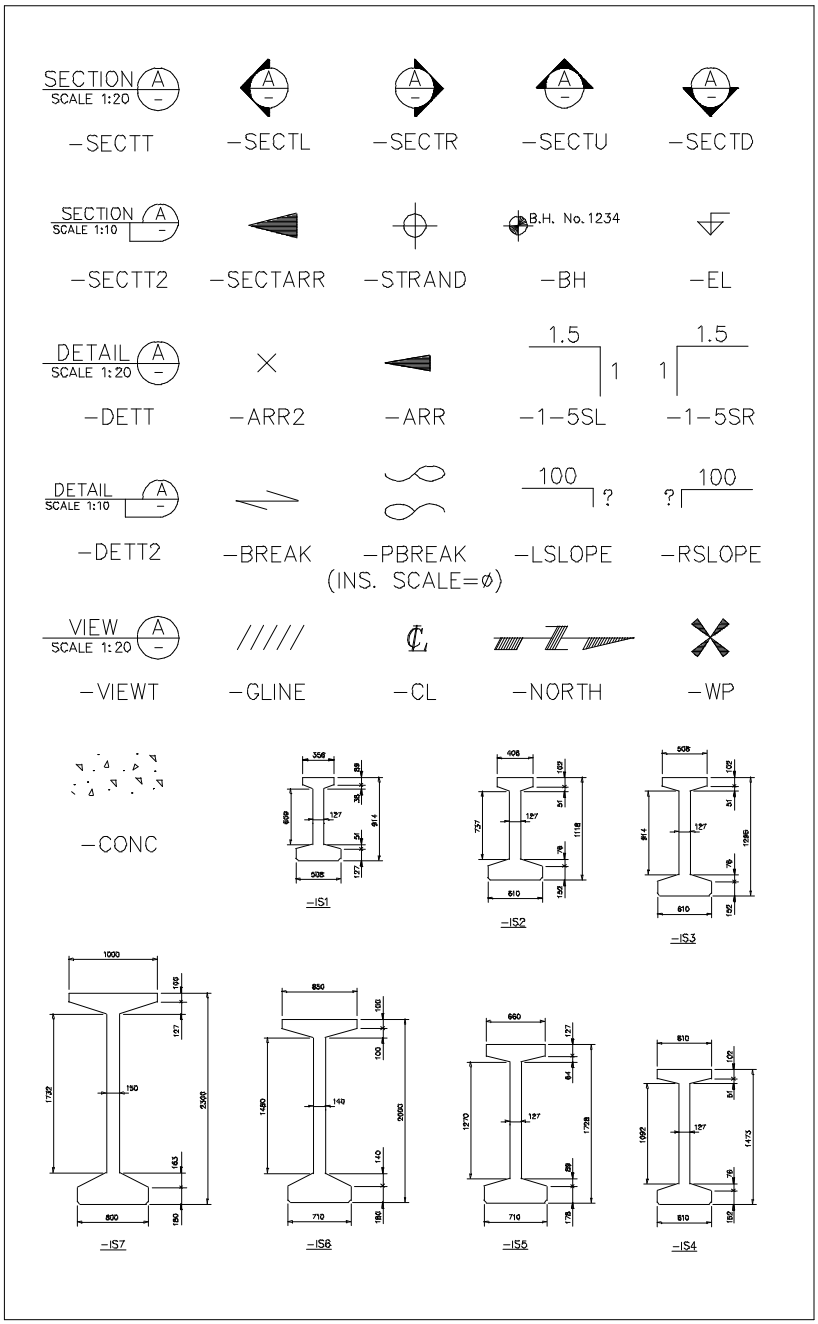
The location of the revised details on the contract drawings shall be indicated by the "**revision letter**" enclosed within a **triangle**.

For example, a **A** shall be drawn adjacent to the revised detail.

All existing revision symbols shall remain on the drawings when subsequent revisions are indicated.

C.2.8 Autocad - Linetype and Layers

C.2.9 Autocad - Standard Library Items



C.2.10 As-Built Drawings

1. Submission and Distribution

In-House and Consultant Design

At the completion of construction, the Project Supervisor will submit marked up prints of all contract drawings showing as-built changes to the Bridge Construction Engineer, Bridge Engineering Section.

In-House Design

See “Office Procedures” for further information.

Consultant Design

1. The Consultant Liaison Engineer will forward the as-built field drawings to the Design Consultant.

2. The Design Consultant shall complete as-built Autocad drawings as per their terms of reference.

3. The Design Consultant shall return as-built Autocad drawings and disks, as per Section 2 “Preparation,” to the Consultant Liaison Engineer.

2. Preparation

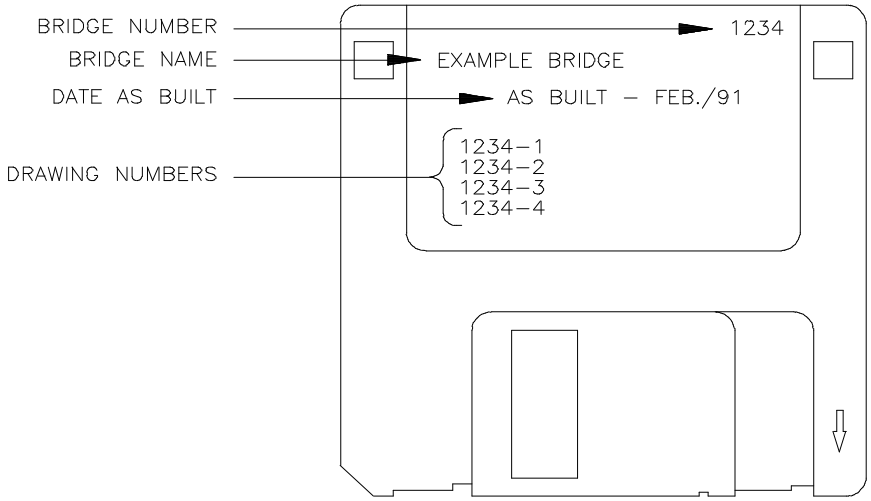
As built Autocad drawings shall be signed by the Design Engineer and all other signature blocks shall state, “ORIGINAL SIGNED BY name (print the name of the original signature). Final quantities for formwork, concrete, uncoated rebars, epoxy coated rebars and structural steelwork shall be tabulated on the relevant as-build drawings.

One (1) set of as built Autocad drawings on 3.5” disks (non-compressed files) shall also be forwarded at the same time for archiving as specified below:

i. One copy of each final drawing (individual drawing files that make up the final drawing need not be supplied).

C.2.10 As-Built Drawings (cont'd)

ii. Disks shall be labelled as shown below:



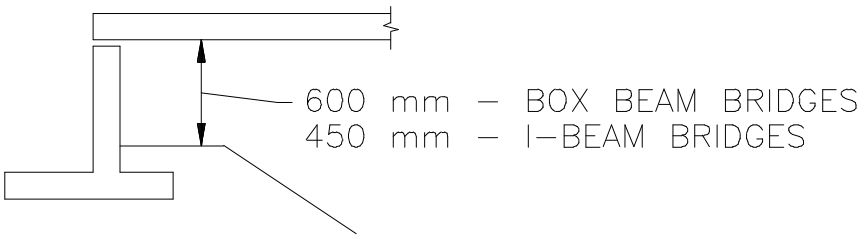
iii. Load as many drawings as possible on one disk without compressing the files.

iv. Quality disks shall be used and all drawings on disks shall be verified before submission for archiving purposes.

C.3.1 Clearances Under Bridges at Abutments

The following minimum clearances shall be maintained between the top of berm and the underside of the superstructure to facilitate the inspection of bridges:

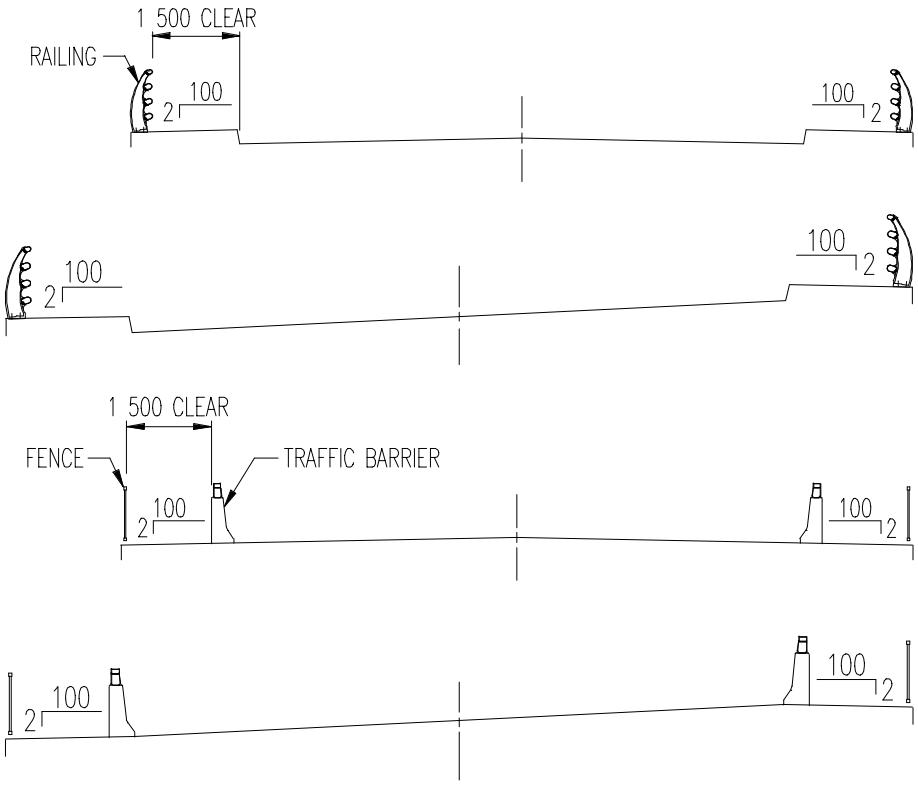
I-Beam Bridges (Steel or Prestressed Concrete) - 450 mm
Box Beam Bridges - 600 mm



C.4.1 Sidewalks

It is the responsibility of the Senior Design Engineer to determine the number of sidewalks on the bridge.

Sidewalks shall have a clear width of 1.5 metres and the top surface shall slope as shown below:



The Senior Bridge Design Engineer shall determine if a traffic barrier will be used to separate the pedestrian and vehicular traffic and the traffic speed shall be taken into account.

Where there is no traffic barrier between the pedestrian and vehicular traffic, the sidewalk shall be raised relative to the concrete deck by a height of 250 mm.

C.4.2 Aluminum Railings

Surfaces in contact with concrete shall be coated with an alkali resistant bituminous paint, and anchor bolt projections and washers shall be coated with an aluminum impregnated caulking.

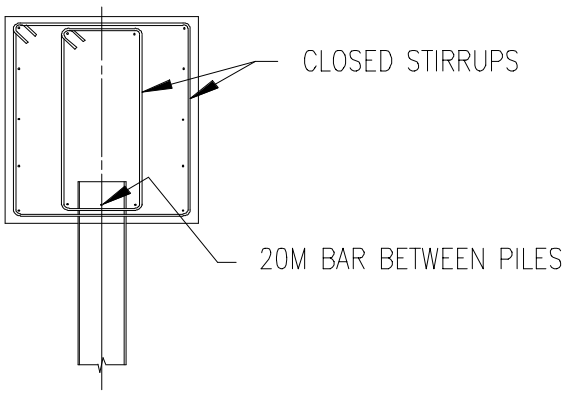
C.5.1 Reinforcing Steel Splices

a) Splices shall be indicated by drawing or note on the drawings using the following standard lengths:

10 M	**12 metre standard lengths**
15 M and greater	**18 metre standard lengths**

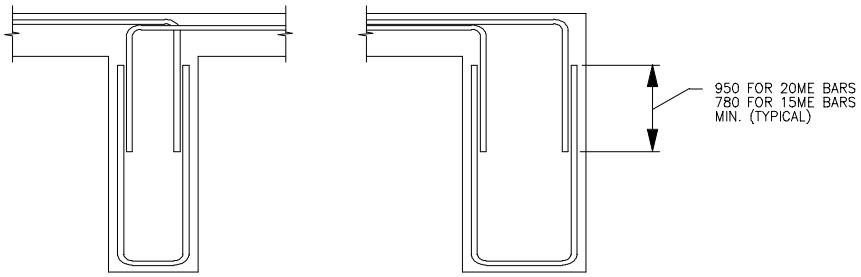
b) Splices indicated on the drawings shall be included in the calculated weight of reinforcing steel.

C.5.2 Reinforcing of Pier Caps



TYPICAL PIER CAP REINFORCING

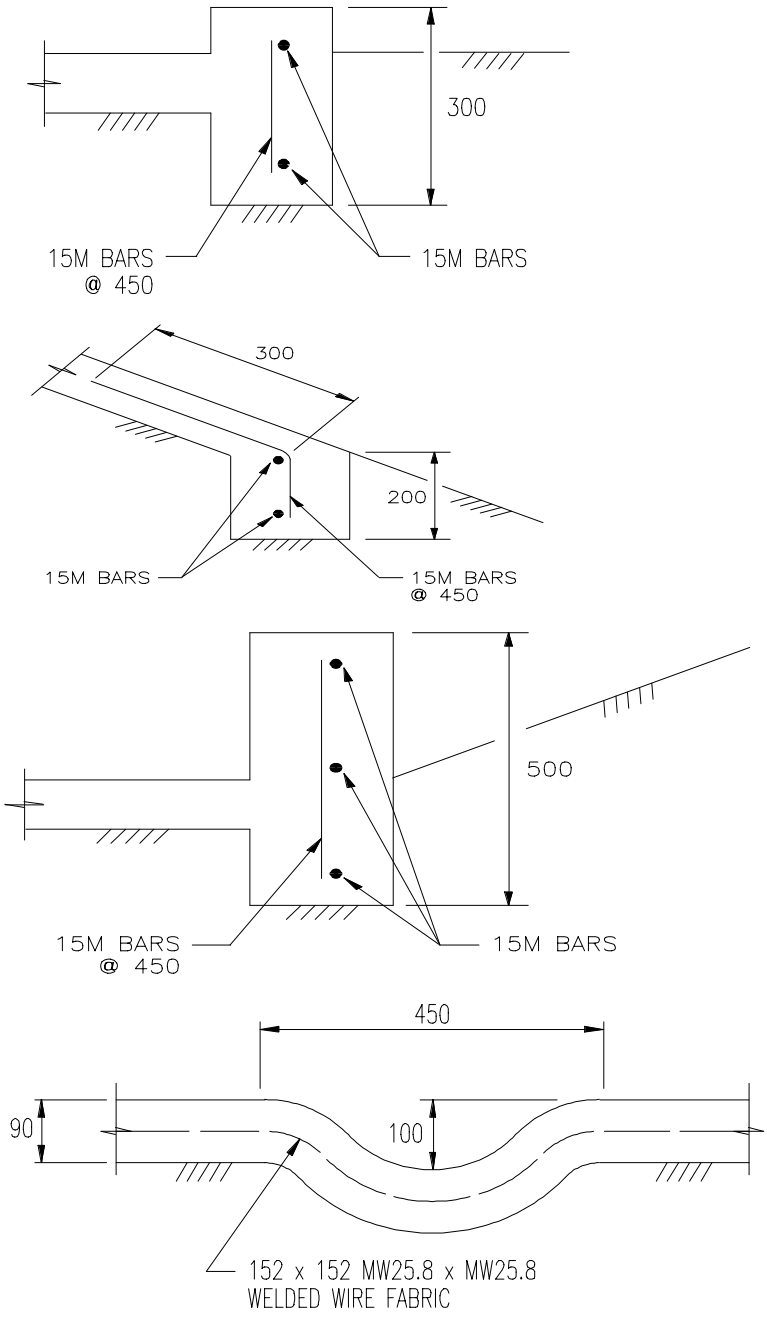
C.5.3 Typical Tie Arrangement



TYPICAL TIE ARRANGEMENT AT INTERMEDIATE AND END DIAPHRAGMS

C.5.4 Slope Pavement

Reinforcing details at edge beams, toe of slope pavement and drainage channels shall be detailed as shown:

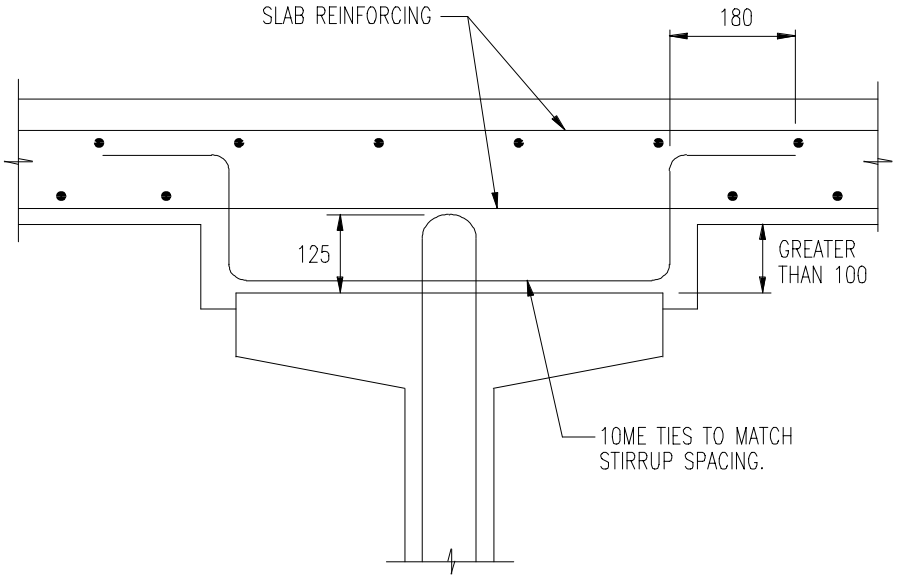


C.5.5 Shear Reinforcing - Prestressed I-Beams

Shear Stirrups in prestressed I-beams shall extend 125 mm above the top of the beam.

When haunch height is less than 75 mm, no additional ties are required in the haunch.

When haunch height exceeds 75 mm, additional ties matching the spacing of the shear stirrups shall be provided as shown below:



C.6.1 Concrete Surface Finishing - Slope Pavement

All exposed surfaces of slope pavements shall be given a broom finish or an exposed aggregate finish. If an architectural finish is required, viz. exposed rock finish for aesthetic reasons, the cost and availability of the material shall be investigated.

C.7.1 Screed Settings

The Design Engineer shall be responsible for establishing the deck screed elevation with the purpose of constructing the deck to the designed vertical alignment.

A line plan of the structure shall be drawn showing the required points, not exceeding 3 metres, at which field elevations are to be taken. The design finished grade elevation and the calculated deflection, due to non-composite and composite dead load, shall then be entered on **Form D501.**

The line plan and Form D501 shall be forwarded to the Project Manager as soon as the Contract Documents are completed.

The field staff shall take field elevations at the points indicated on the line plan and forward them to the Project Manager for onward transmission to the Design Engineer/Technician.

Using the designed deck thickness, haunch heights shall then be calculated by the Design Engineer/Technician.

Using the designed deck thickness, haunch heights shall then be calculated by the Design Engineer/Technician.

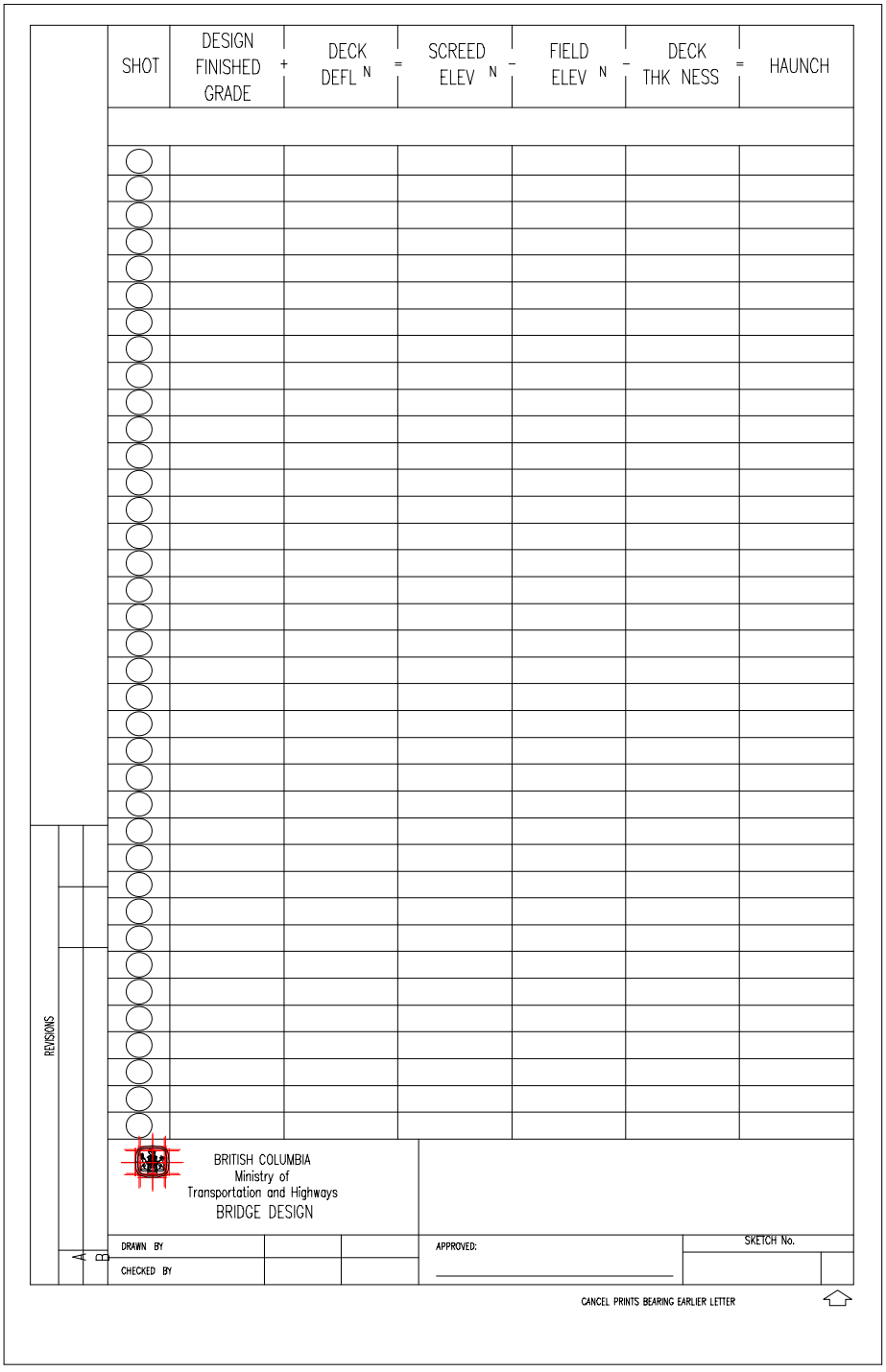
In the event that the calculated haunch height is negative, the finished vertical alignment shall be redesigned. If the haunch height reduces the deck embedment of stud shear connectors on steel stringers to less than 50 mm, then the vertical alignment shall be redesigned.

Where prestressed concrete “I” beams are used, the haunch height shall not exceed 100 mm unless further additional horizontal shear reinforcement is provided.

Screed elevations are entered in **Form D501** and forwarded to the Project Manager.

Screed and field elevations should not be transmitted by telephone.

C.7.2 Screed Settings - Form D501



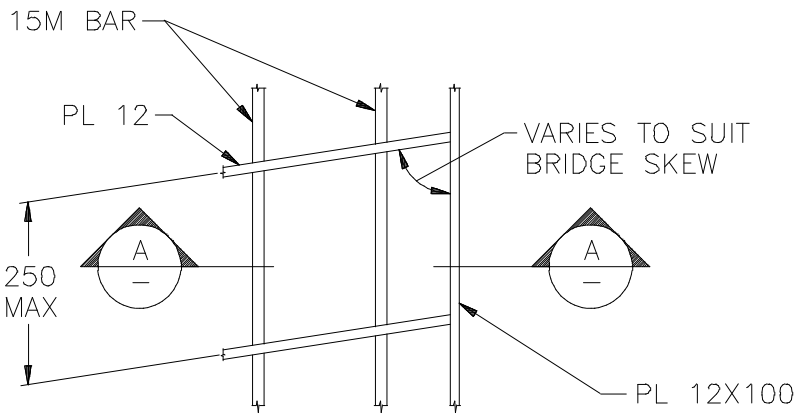
C.8.1 Minimum Thickness of Ballast Walls

The minimum thickness of ballast walls shall be 350 mm.

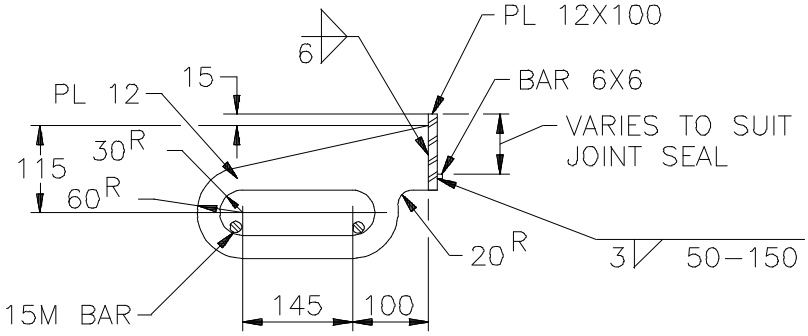
C.9.1 Weathering Steel - Painting Adjacent to Deck Joints

Weathering steel girders shall be painted over a distance of 1.5 x depth on either side of deck or rotational joints. The colour of the finish coat shall be an acceptable match to the oxidized steel surfaces.

C.10.1 Expansion Joint Armouring Details - Decks



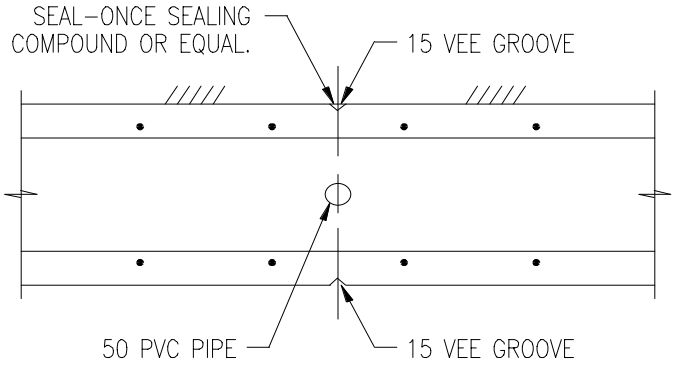
PLAN



SECTION A

C.10.2 Control Joints - Abutments, Bearing Seats, Retaining Walls and Wingwalls

Control joints in abutments, bearing seats, retaining walls and wingwalls shall be spaced at not more than 3 metres through the length of the wall and shall be detailed as shown below:

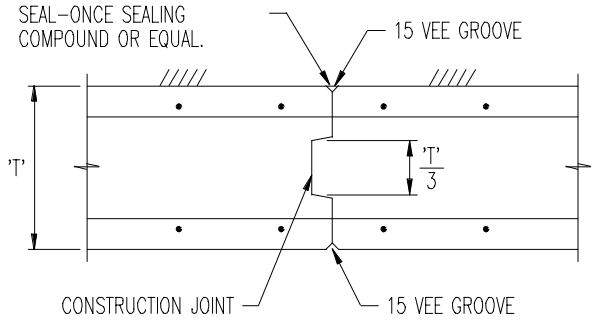


C.10.3 Control Joints - Slope Pavement

Control joints extending from side to side of the slope pavement shall be spaced at no more than 3 metre intervals. Mesh reinforcing shall be continuous across these joints.

C.10.4 Control Joints - Concrete Traffic Barriers

Control joints shall be evenly spaced through the length of the barrier and their spacing shall not exceed 5 metres. They shall extend around the perimeter of the barrier as shown below:

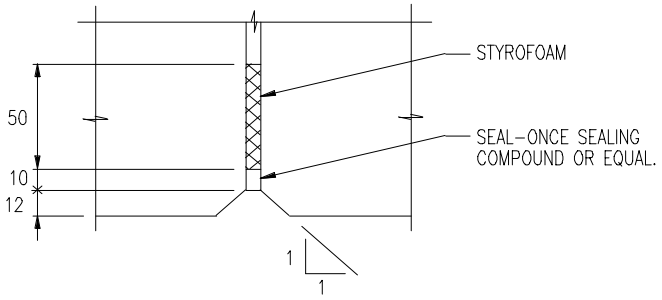


C.10.6 Construction Joints - Slope Pavement

Vertical construction joints extending from top to bottom shall be spaced at not more than 3 metre intervals. Mesh reinforcing shall be terminated at these joints.

C.10.7 Saw-Cut Joints - concrete Traffic Barriers

Concrete traffic barriers shall have a 6 mm joint over the supports on continuous spans. The joints may be saw-cut, but the structure shall not be subjected to a single vehicle live load greater than 5 Kn prior to the cutting operation.



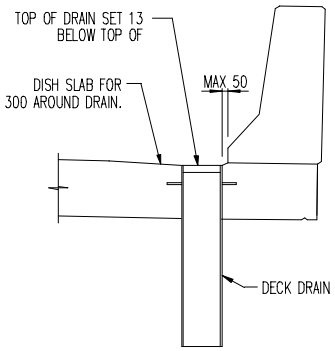
C.10.8 Fixed Joint Armouring Details

The fixed joints for the decks shall be fabricated in suitable lengths for handling purposes and connected in the field.

C.11.1 Deck Drains

Drain pipes shall be straight to facilitate cleaning and shall be designed for the 10 year design storm with the gutter flow encroaching not more than 1.2 metres on the traffic lanes. Drains shall be galvanized in accordance with the Notes on the contract drawings and visible sections outside the bridge shall be painted to match the painted steel superstructure or the colour of the AT Steel of the main members.

Support brackets may be required for girders and steel trusses deeper than 2.3 metres.



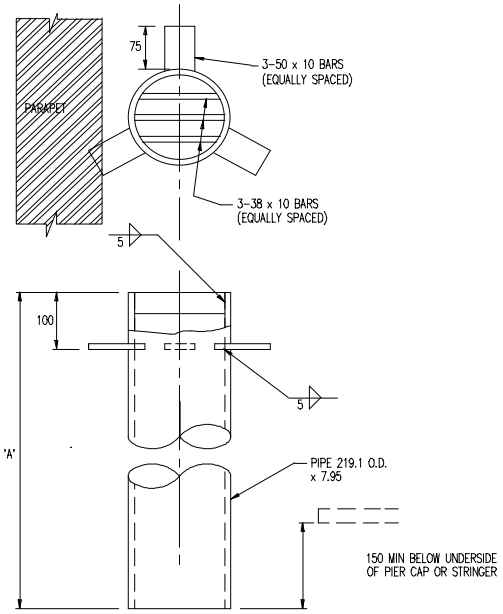
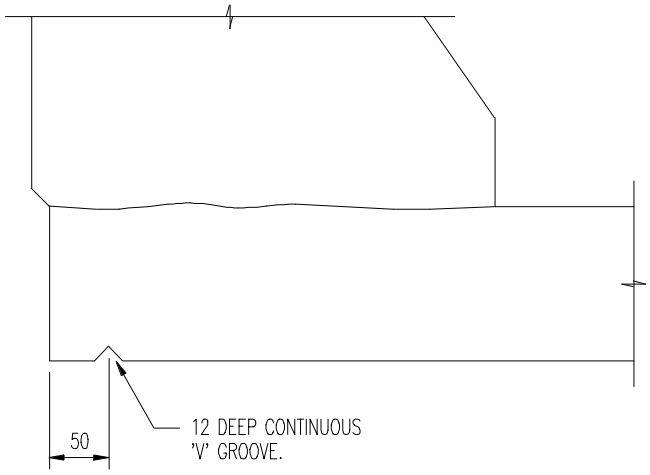


TABLE OF REQUIREMENTS			
DRAIN	Mk. D1	Mk. D2	Mk. D3
'A'			
No. REQ'D.			
MASS EA.			

C.11.2 Drip Grooves

Drip grooves shall be detailed as shown below:

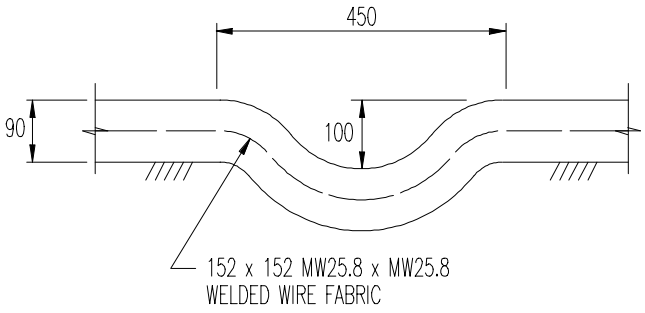


C.11.3 Drains - Abutments and Retaining Walls

100 mm diameter drains at 4 metre spacing shall be used when abutments or retaining walls are located in cuts. Drains are not required for abutments located on compacted standard granular bridge end fills.

C.11.4 Drainage Channels - Slope Pavements

Decks draining onto slope pavements shall be directed towards drainage channels. Drainage channels shall be detailed as shown below:



C.12.1 Premoulded Joint Filler

Premoulded joint fillers on bridge structures shall consist of 25 thick Evazote 50, or Ole-Tex XE-300 or approved equal and shall be applied in accordance with the manufacturer's instructions.

C.13.1 Dowels

Prestressed Concrete Box Stringers

a) **Dowel Holes (Fixed)**

Dowel holes shall be filled with a non-metallic, non-shrink grout with a minimum compressive strength of 25 MPa at 7 days.

b) **Dowel Holes (Expansion)**

Dowel holes shall be filled with styrofoam granules and a space shall be provided at the top of the dowel for vertical movement.

C.14.1 Shear Keys

Prestressed Concrete Box Stringers

Shear keys between adjacent boxes shall be filled with 12 mm aggregate concrete having a minimum compressive strength of 35 MPa at 28 days.

The quantity of concrete required to fill the shear keys shall be considered as part of the quantity for deck concrete.

C.15.1 End Diaphragms - Hole Sizes Through Ends of I-Girders

The hole sizes for rebars through the ends of Prestressed I-Girders for end diaphragms shall be **50 mm diameter for 20 M bars.**

C.16.1 Tip Elevations and Design Load

The following information shall be shown on the appropriate substructure drawings:

i. Anticipated Pile Tip Elevation

ii. Maximum Pile Tip Elevation

iii. Design Load (Unfactored)

COMMENTARY
DESIGN STANDARDS

C.B.2 Roadway Widths on Bridges

Roadway widths on bridges are influenced by geometric design elements and operational characteristics of the approach roadway. A roadway network is broadly classified into rural and urban roads. These are further subdivided into local, collector, arterial and freeway. Roadway classification is based on service function, traffic volume, flow characteristics, design speed, vehicle type, etc. Lane width and condition of the road surface have a significant influence on the safety and comfort of the traveling public.

A shoulder adjacent to the outside traffic lane is provided as a safety allowance. For major highways, standard shoulder widths of 2 metres or greater is provided as a refuge for disabled vehicles and for travel by emergency vehicles. It is desirable to carry the full shoulder width across the bridge to eliminate the hazards of the offsets at the ends of the bridges. If this requirement is not met, it is advisable to investigate the safety implications with the **Director of Safety Engineering.**

Pavement widening on curves is carried out to provide for the off-tracking characteristics of vehicles on curves. Maintaining a vehicle centrally located on a lane is more difficult on a curve than on a tangent section.

On costly long span bridges some width restrictions may be appropriate.

The above factors have been taken into consideration in determining roadway widths and shying distances as shown in **Tables B1 to B4.**

Reference: RTAC - Manual of Geometric Design Standards for Canadian Roads.

C.B.3 Clearances

The factors controlling vertical clearances for underpasses and overpasses are vehicle height plus allowance for repaving, live load deflection and vehicle bounce. Vertical clearance under pedestrian overpasses and sign bridges is greater than for vehicular bridges because the pedestrian overpasses and sign bridges are generally of lighter construction than vehicular bridges and are susceptible to greater damage if hit by high vehicles. The vertical clearances set forth in this statement are slightly greater than, but consistent with minimum clearances recommended in the **RTAC Manual of Geometric Design Standards for Canadian Roads and the Ontario Highway Bridge Design Code.**

C.B.3 Clearances (cont'd)

Horizontal clearances depend to a great extent on whether the roadway is on the tangent or on the curve. Increased clearances based on minimum stopping sight distances are required when the roadway is on a horizontal curve. Minimum stopping sight distance is the sum of the two distances traveled from the instant the object comes into view until the vehicles comes to a stop, viz. distance traveled during brake reaction time and the distance traveled during braking. Braking distance on tangent sections of the roadway is based on assumption that the entire longitudinal friction is available for braking. In the case of a vehicle traveling on a horizontal curve, some of the available friction is utilized to produce the radial acceleration, leaving a reduced friction for braking. For this reason, it is necessary to increase the minimum stopping sight distance on horizontal curves. It has been found that this correction is critical for speeds of 60 Kph to 90 Kph on horizontal curves with minimum radii.

When breaking occurs on a downgrade, the braking distance is increased and the converse effect occurs on an upgrade.

Vertical and horizontal clearances for railways conform to the requirements of the Canadian Transport Commission.

C.B.4.1 Railings and Parapets

Railings are installed on concrete parapets for the safety and protection of the pedestrian traffic and are not required for vehicular traffic. For bridges with one sidewalk, railings are installed on both concrete parapets for the safety of errant pedestrians who don't use the sidewalk.

Railings are not required on concrete parapets for bridges with two sidewalks.

The installation of railings on concrete parapets is an additional cost item for bridges having no provision for sidewalks. In remote areas, where the pedestrian traffic is negligible, railings can be omitted on concrete parapets and can be installed in the future when the volume of pedestrian traffic increases.

C.B.4.4 Extruded Barriers

It has been observed that extruded concrete barriers do not result in a water-tight joint at the interface with the deck and the seepage of water has resulted in the staining of the deck and superstructure.

C.B.6.3 Minimum Reinforcing of Flexural Members

The intent of this amendment is to make **Clause 8.2.4.2** of **CAN/CSA-S6-88** consistent with **Clause 8.4.2** of **CAN3-S6-M78** and to minimize the use of excessive amounts of steel in pier caps and footings.

C.B.6.4 Reinforcing of Pier Caps

The preferred arrangement for shear reinforcement alleviates the problems encountered with the installation of longitudinal rebars when the driven piles are slightly off alignment. This enables the placement of two of the longitudinal bars in close proximity to the piles. The other method of providing two identical lapped closed stirrups does not provide much tolerance for the placing of the two longitudinal bars adjacent to the piles.

C.B.6.5 Typical Tie Arrangement

Problems are encountered with U-stirrups in the intermediate and end diaphragms when the stirrups end up being either too short or too long depending on the depth of the haunches. The alternative method of using U-stirrups of suitable depth for the splicing of right-angle bars will alleviate problems in accommodating for the variations in the depth of the diaphragms.

C.B.7.2 Concrete Finish on Abutments and Retaining walls

Section 211.16.2 of the Standard Specifications for Highway Construction specifies a **Class 2** finish on all formed surfaces exposed to view from a moderate distance and explains the requirements for producing the finish.

For large areas of exposed concrete located in developed or landscaped surroundings, an architectural finish would provide an aesthetic effect. A ribbed finish may be suitable in locations subject to defacement. While a specific finish tends to discourage graffiti, it will be also more difficult to clean off and one should consider this factor when selecting the finish.

C.B.8.2 Deck Heating

Heating systems have not generally functioned for more than one year. The negative results of snow melt which freezes in non-heated areas have basically deterred any repair work to these systems.

Currently the Province of Alberta, Saskatchewan and Ontario do not use heating systems.

C.B.8.3 Continuous Decks

There has been a growing tendency towards the design of joint-free continuous bridges in recent years. The main weakness in the various forms of deck joints has been the lack of durability and associated maintenance problems.

Continuity in bridge decks with pretensioned precast concrete girders has been researched and designed since 1960.

Damage to deck joints can be attributed to the increase in traffic volumes, especially heavier vehicles. Impact forces caused by vehicles passing over expansion joints combined with poor detailing have resulted in the leakage of surface run-off and de-icing salts to the substructure and bearings. Reinforced concrete crossheads and piers often corrode following attack by chloride penetration.

A single line of bearings in lieu of a double row of bearings over the piers may result in a reduction in construction costs.

C.B.9.1 Minimum Thickness of Ballast Walls

The minimum thickness is of particular importance for deep ballast walls while using a hose for pumping concrete.

C.B.9.2 Approach Fill Widths at Abutments

The clause conforms to the typical roadway cross-sections and fill slopes used by the **Highway Engineering Branch**. The top of wingwall is set 100 mm above the fill line to prevent the fill from spilling onto the bearing locations.

C.B.10.2 Structural Steel - Material Sizes and Availability

Section 1A of “Algoma Steel - Standards and Specifications” lists the maximum lengths and widths for different thicknesses of steel plate. A trim allowance of 9 mm to 12 mm around the perimeter of the plate is recommended to account for unfinished edges. These limitations shall be taken into consideration when sizing plates and splices are introduced when size limits are exceeded.

C.B.10.5 Fatigue in Riveted Connections

The stress category for riveted connections is not addressed in **CAN/CSA-S6-88** whereas it is specified as **Category D** in **AASHTO** and **OHBDC.** This category will be useful during the evaluation and rehabilitation of existing riveted bridge structures.

C.B.11.1 Diaphragms

The inaccessibility of bearings creates a major problem for their inspection and maintenance. In the past, consideration has been paid to bearing accessibility. A suitable gap should always be provided between the top of the bearing shelf and the soffit of the diaphragm, and as many sides of the bearing should be accessible as possible.

If a bearing cannot be properly inspected, it is very unlikely that it will be adequately maintained.

C.B.11.2 Minimum Thickness of Diaphragms

See Clause C.B.9.1.

C.B.11.3 Steel Diaphragms

It is advantageous, particularly during the installation stage, to use intermediate steel diaphragms for precast concrete bridges that are not skewed.

C.B.13.1 Bearing Details

The use of concrete shear keys may be considered for lateral seismic load restraint. Shear keys can be used in addition to the anchor bolt details.

C.B.14.1 Scuppers

Scuppers for lateral drainage may be more effective and practical on flat grades than having drainpipes installed in the prestressed concrete box stringers. The scuppers are easily installed on a slope with the outlets fully embedded in the deck overlay prior to the construction of the concrete parapets.

C.B.14.2 Drainage of Surfaces Adjacent to Bridge Bearing Seats

The sloped surfaces adjacent t the bearing seats will enable water passing through the deck joints to drain away.

COMMENTARY
DRAFTING STANDARDS

C.C.1.2 Dimensioning

The main purpose of this clause is to achieve uniformity in the dimensioning procedures and generally it follows the standards accepted by industry.

C.C.4.1 Sidewalks

The minimum sidewalk width of 1.5 metres for two pedestrians is recommended in **OHBDC.**

When the concrete parapet separates the pedestrian and vehicular traffic, the sidewalks are sloped away from the roadway to facilitate drainage. The sloping of the sidewalk away from the roadway is also recommended for sidewalks adjacent to roadway curbs.

C.C.5.2 Reinforcing of Pier Caps

See Commentary - Design Standards, Clause C.B.6.4.

C.C.5.3 Typical Tie Arrangements

See Commentary - Design Standards, Clause C.B.6.5.

C.C.5.5 Shear Reinforcing - Prestressed E-Beams

Additional shear reinforcing in the haunch is governed by the height of the haunch in relation to the extension of the web shear reinforcing above the top of the beam. Additional ties shall be provided if the top of the web shear reinforcing is below the bottom reinforcing of the deck.

C.C.8.1 Minimum Thickness of Ballast Walls

See Commentary - Design Standards, Clause C.B.9.1.

C.C.10.1 Expansion Joint Armouring Details

The preferred arrangement for the expansion joint armouring details will facilitate installation and minimize conflict with deck reinforcing in skewed bridges. The units are fabricated in sections for handling purposes and galvanized in accordance with CSA Standard G164, Table 1, before being connected and installed on site.

C.C.10.2 Control Joints - Abutments and Retaining Walls

Joints are made in concrete elements to prevent the concrete from cracking at other locations. The shrinkage control joints are grooves cast in concrete for confining the cracks within the place of weakness adjacent to the 50 mm PVC pipe.

C.C.10.4 Control Joints - Concrete Traffic Barriers

The V-Groove joints are cast in concrete to confine cracking within these locations.

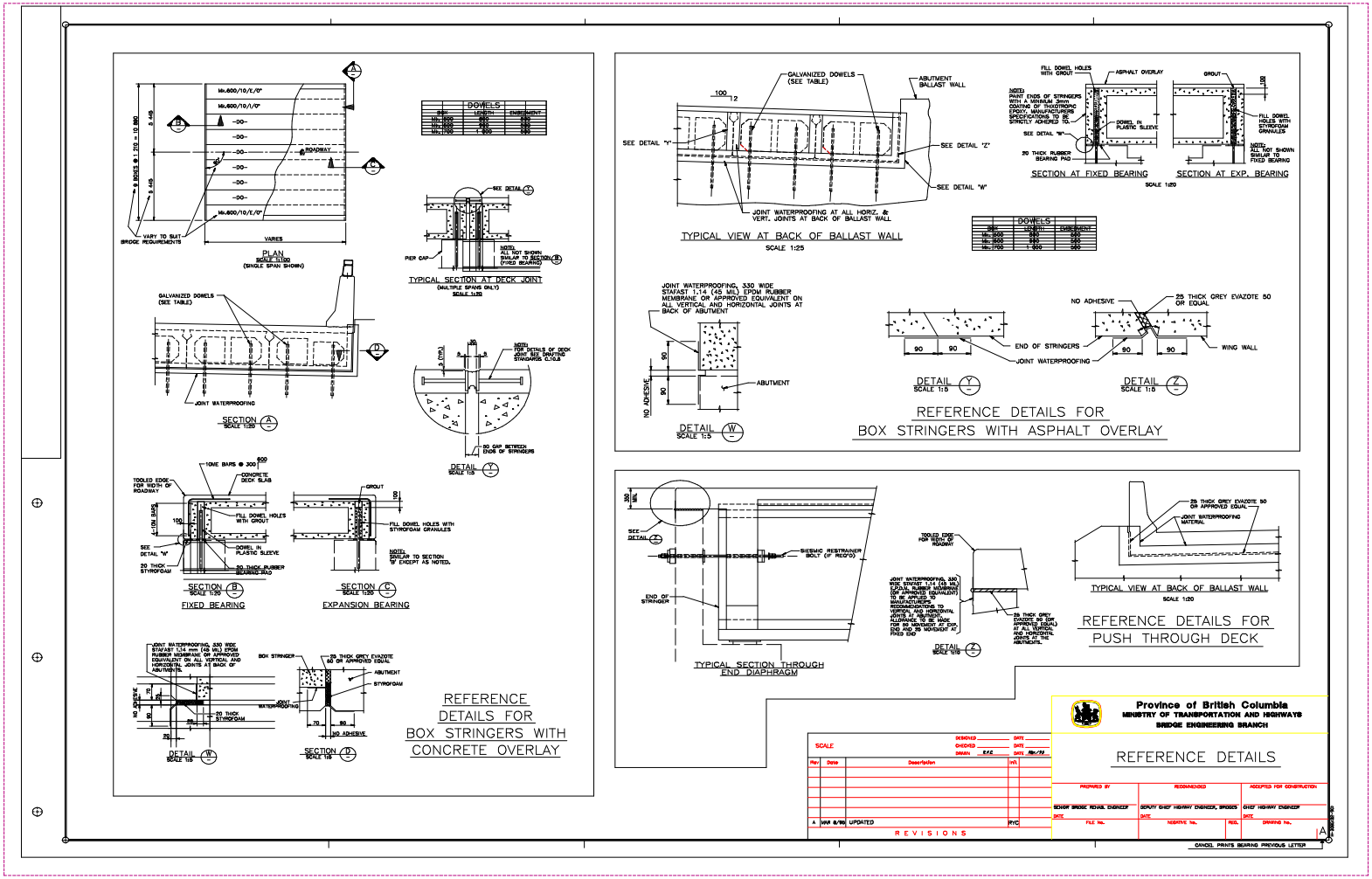
C.C.11.2 Drip Grooves

Drip grooves prevent water containing deicing salts from affecting the girders and the underside of the decks.

C.15.1 End Diaphragms - Hole Sizes Through Ends of I-Girders

The recommended hole size of 50 mm in diameter for 20 M bar will ensure an adequate minimum cover for the concrete diaphragms. Slotted holes shall be provided for skewed bridges.

D.1.1 Reference Details



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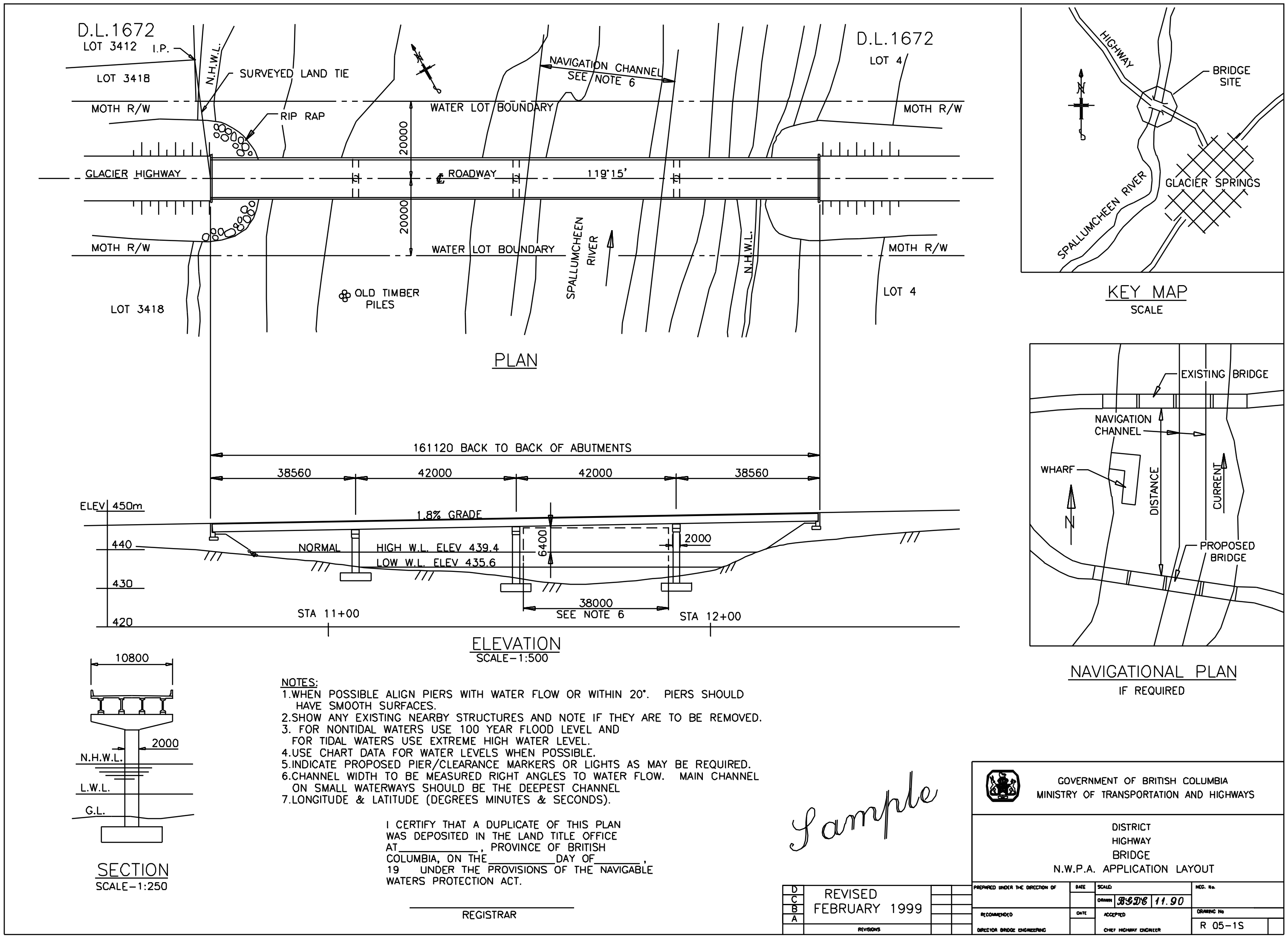

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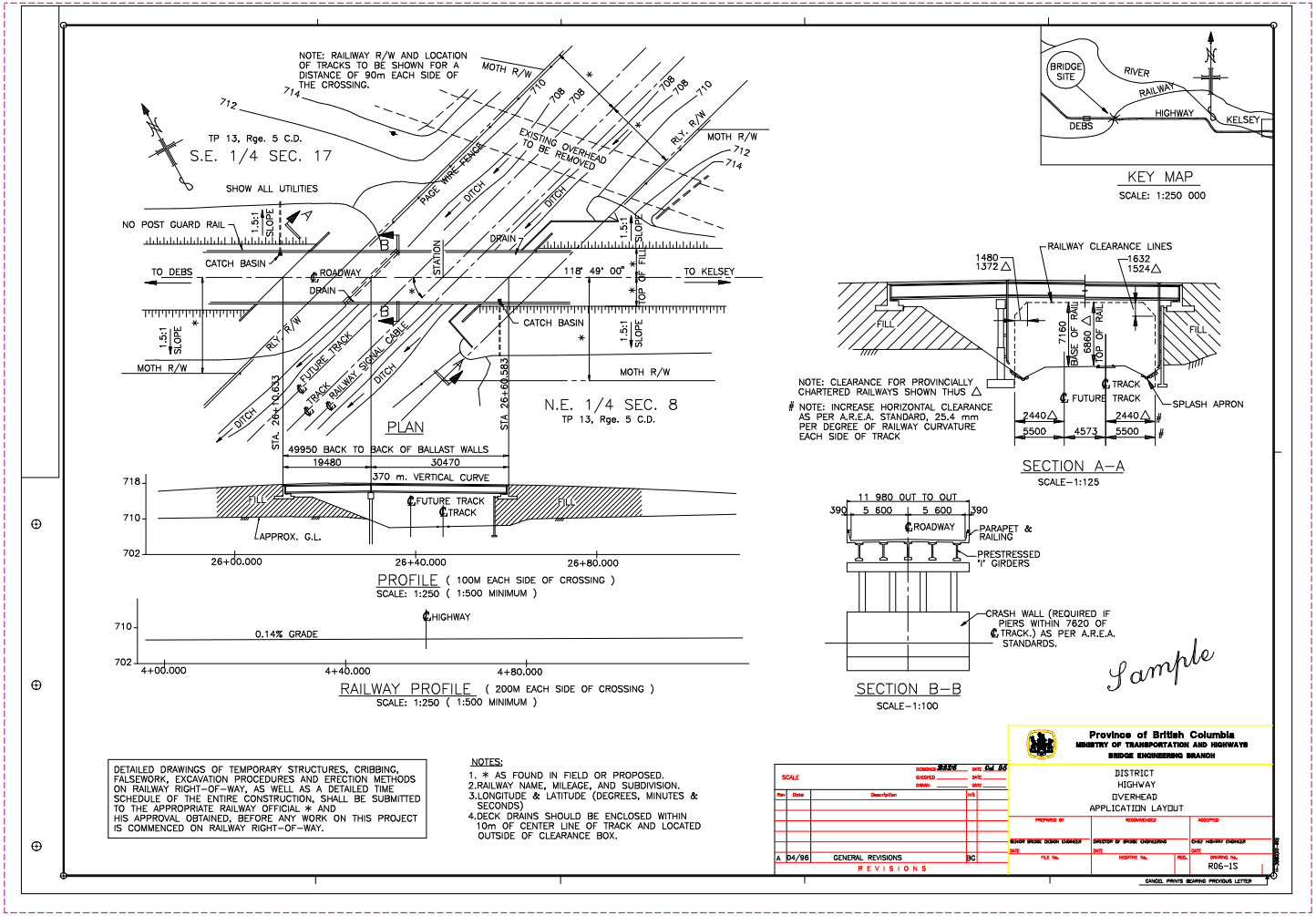

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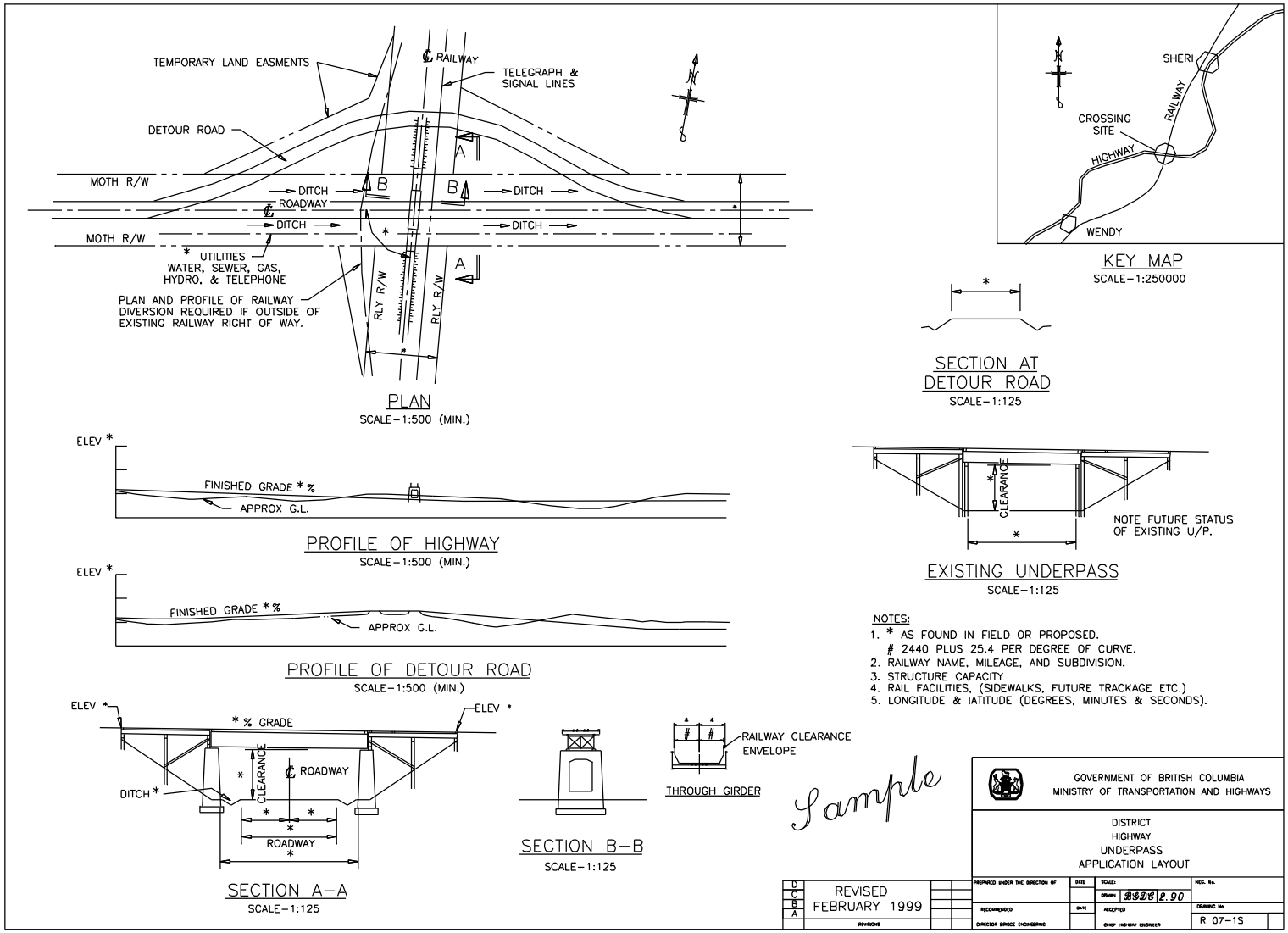

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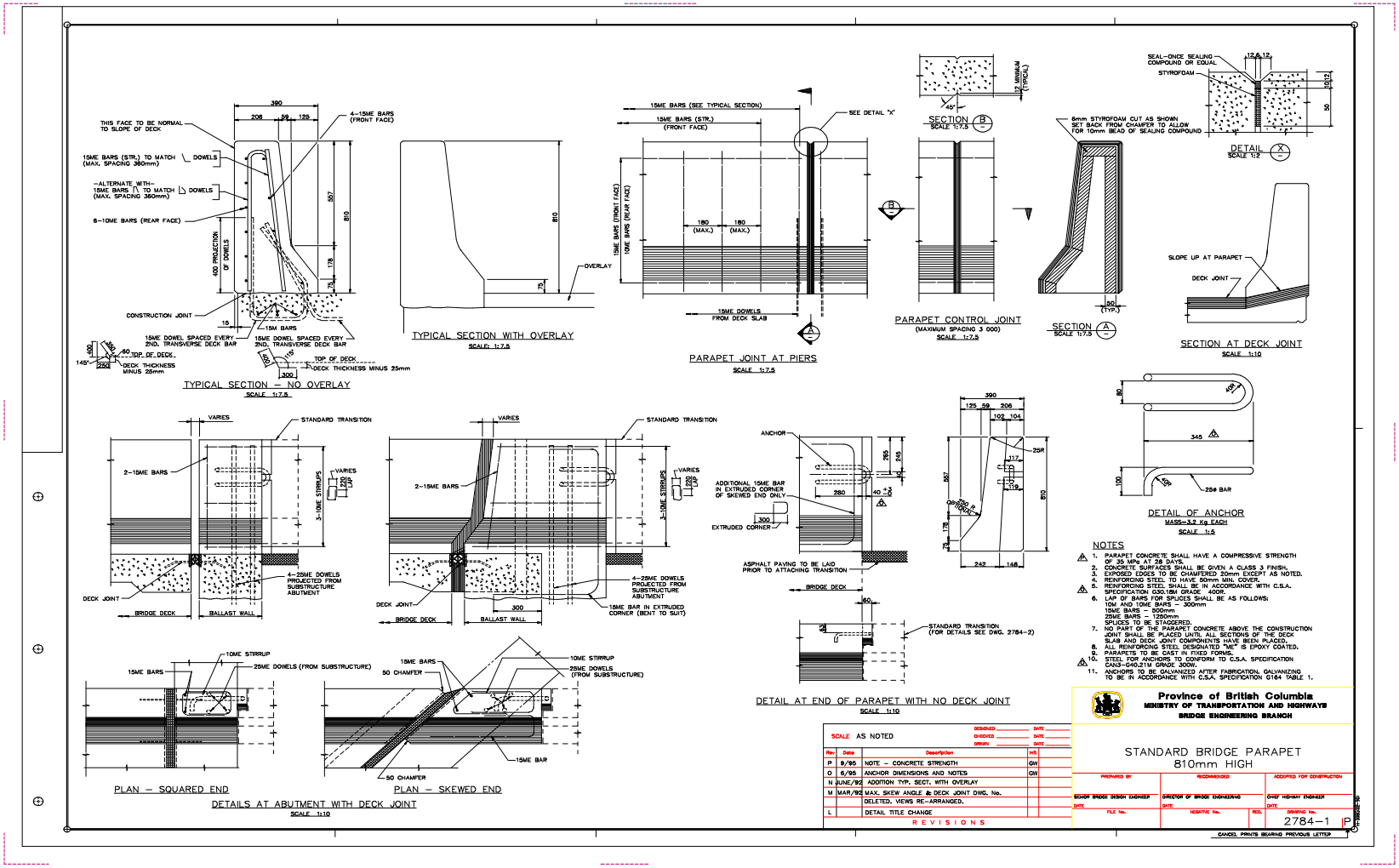
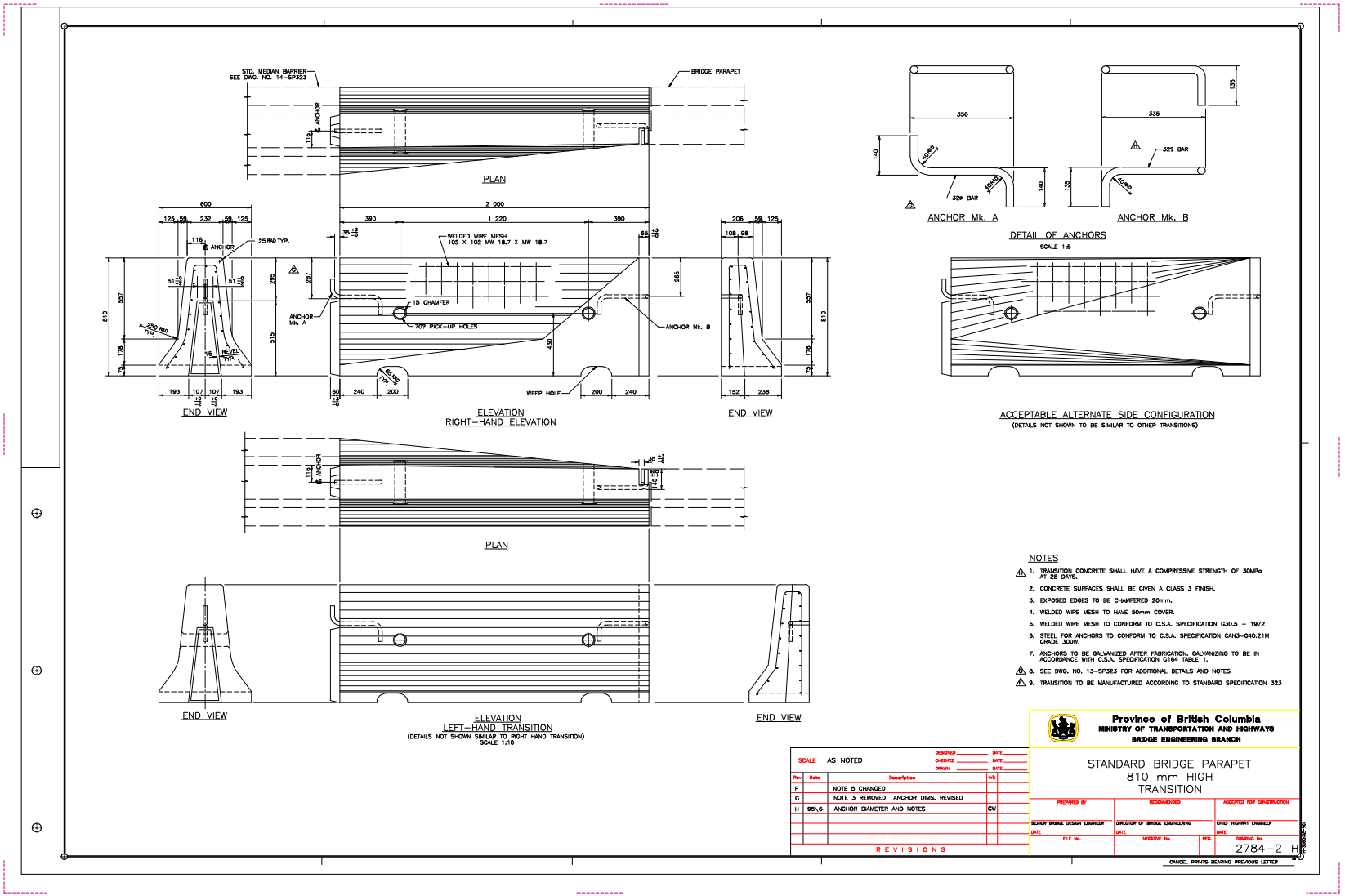


D.4.2 Standard Bridge Parapet 810 mm High, Transition



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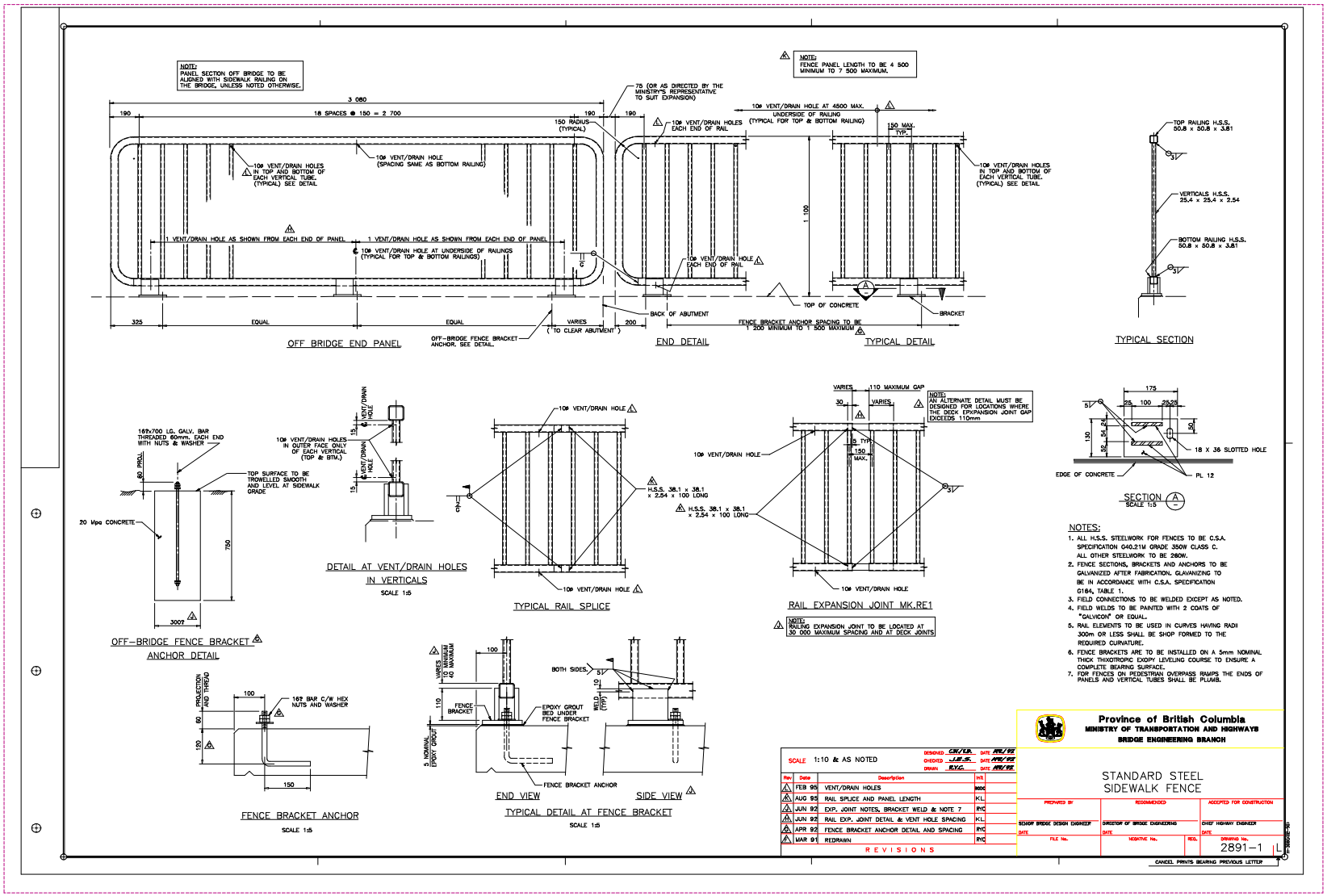
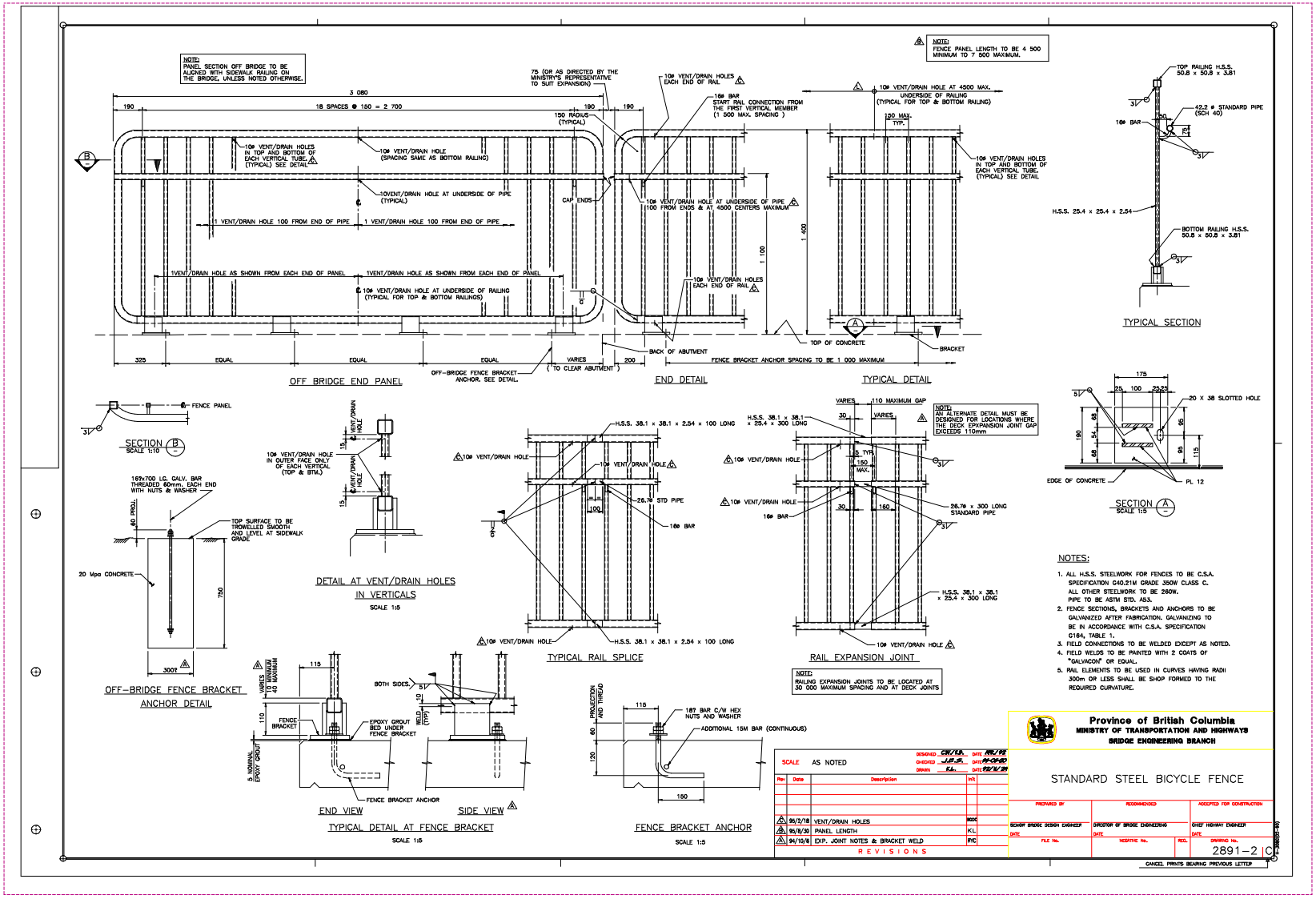


D.5.3 Standard Steel Bicycle Fence



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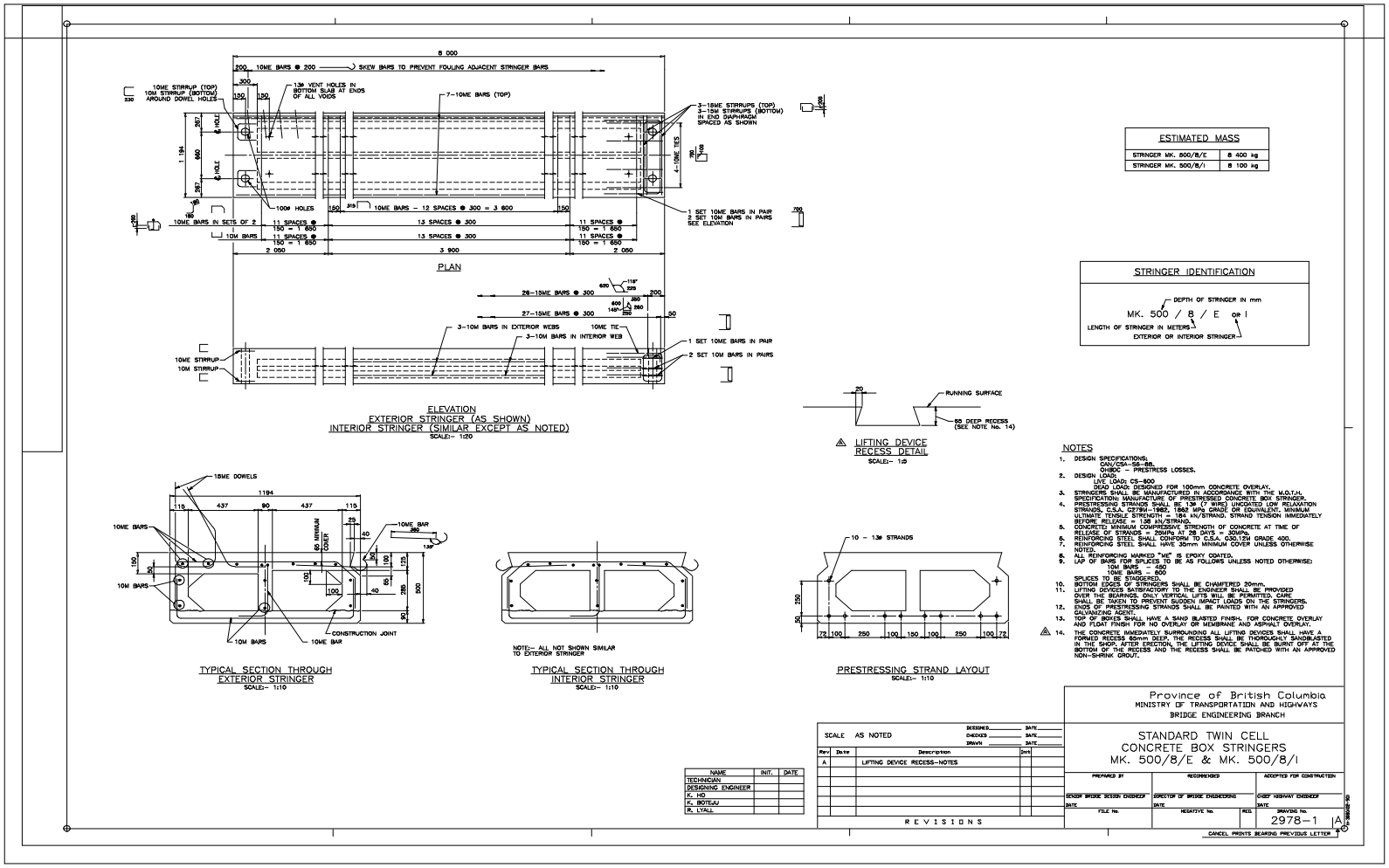

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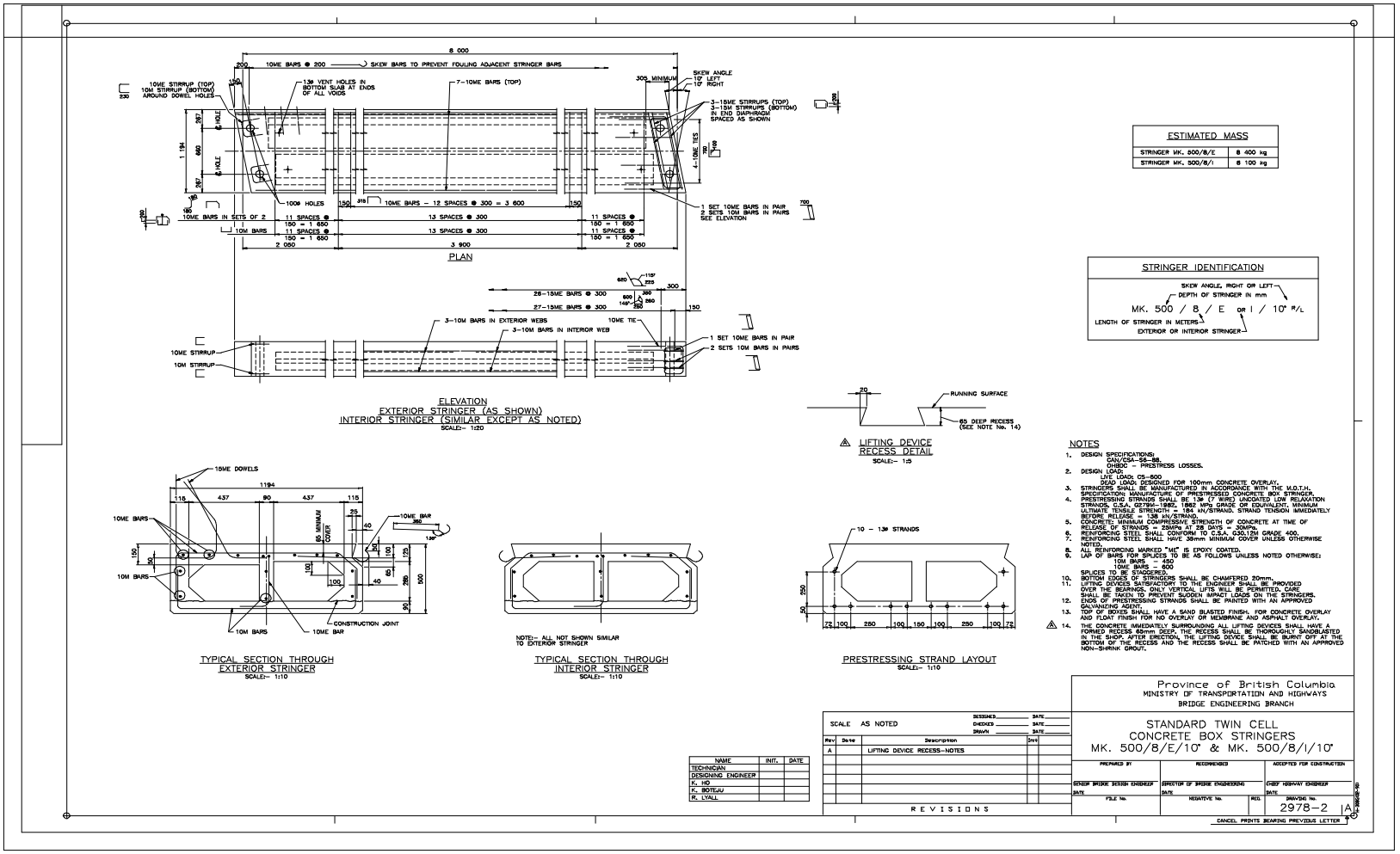

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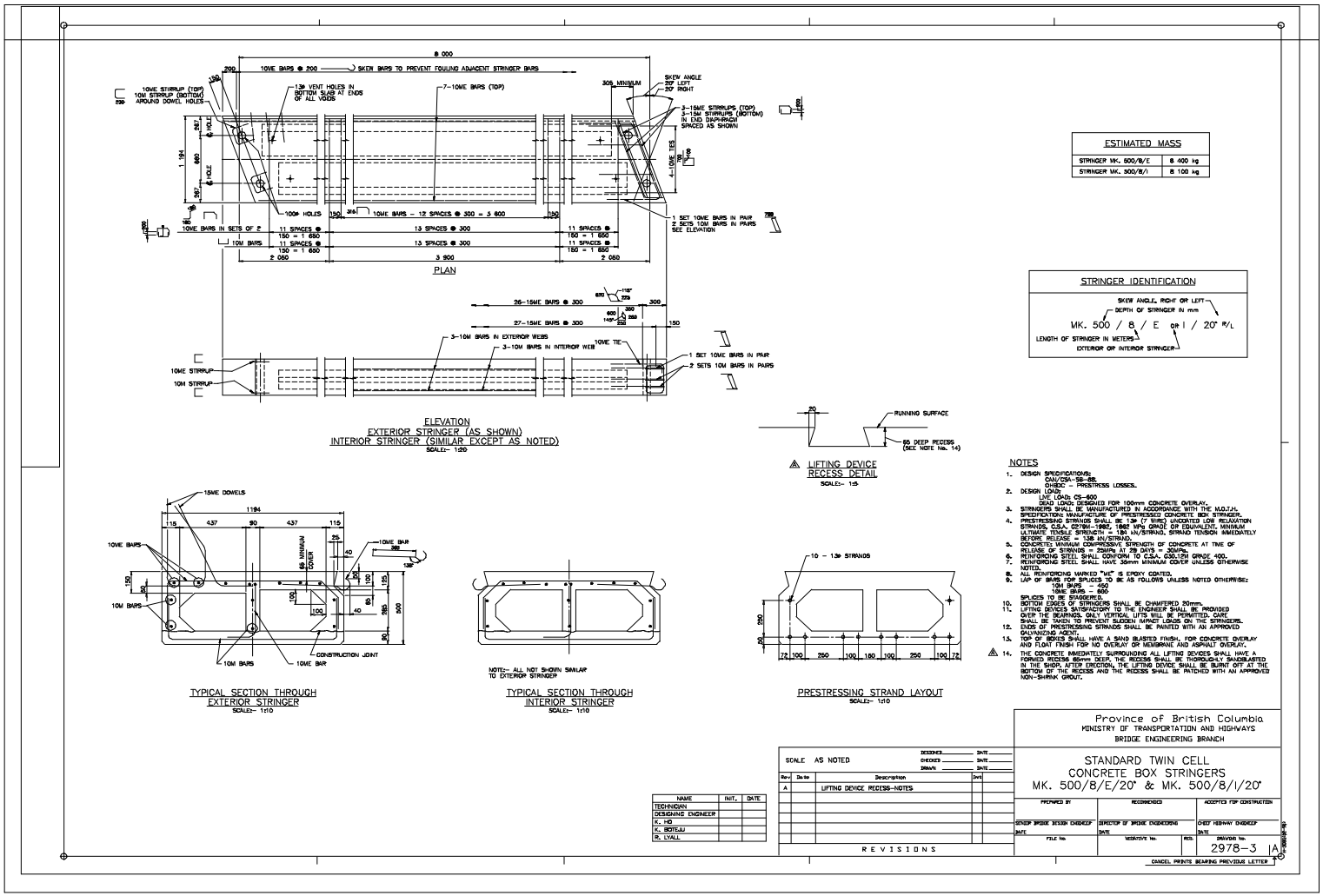

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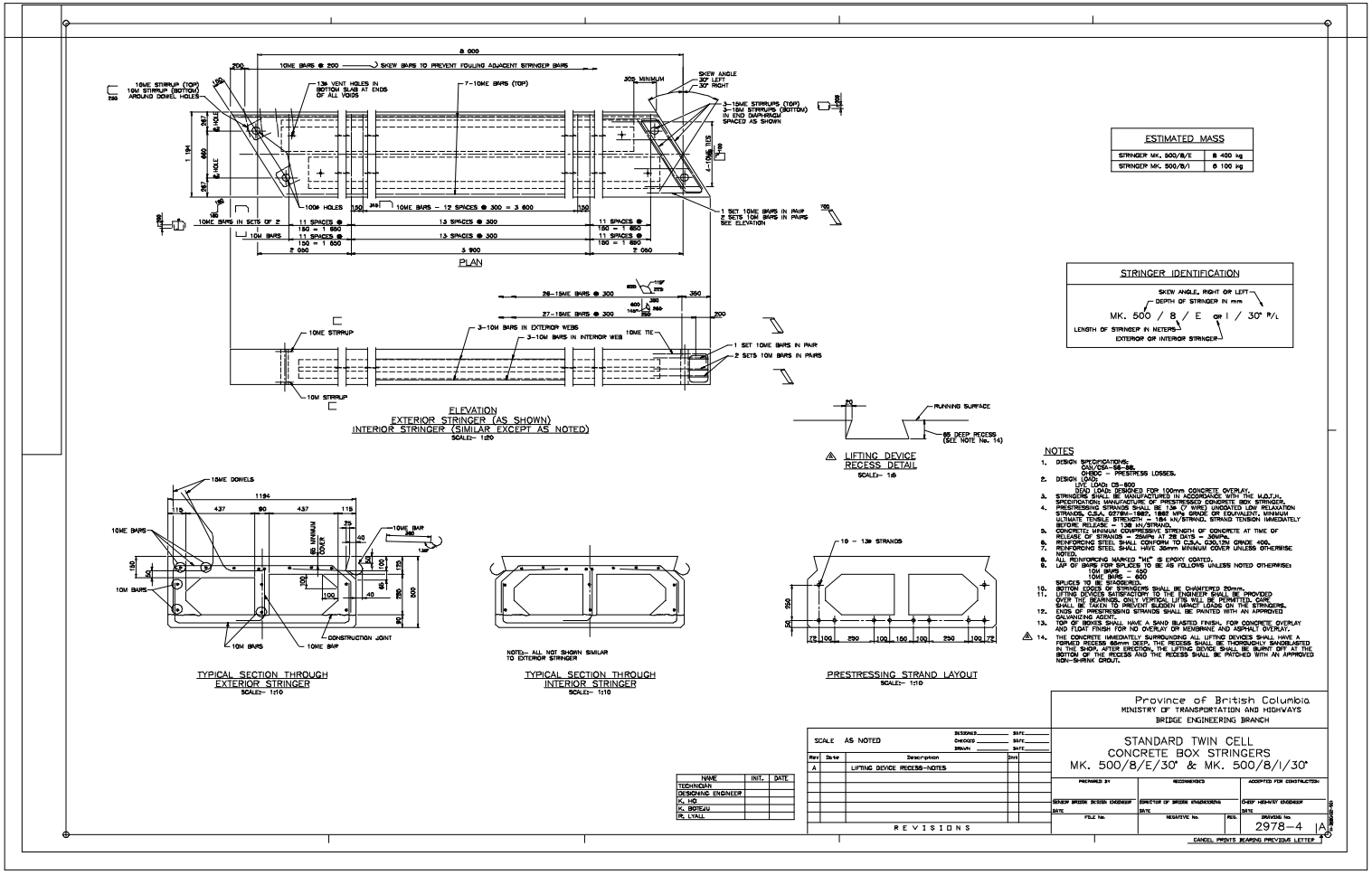

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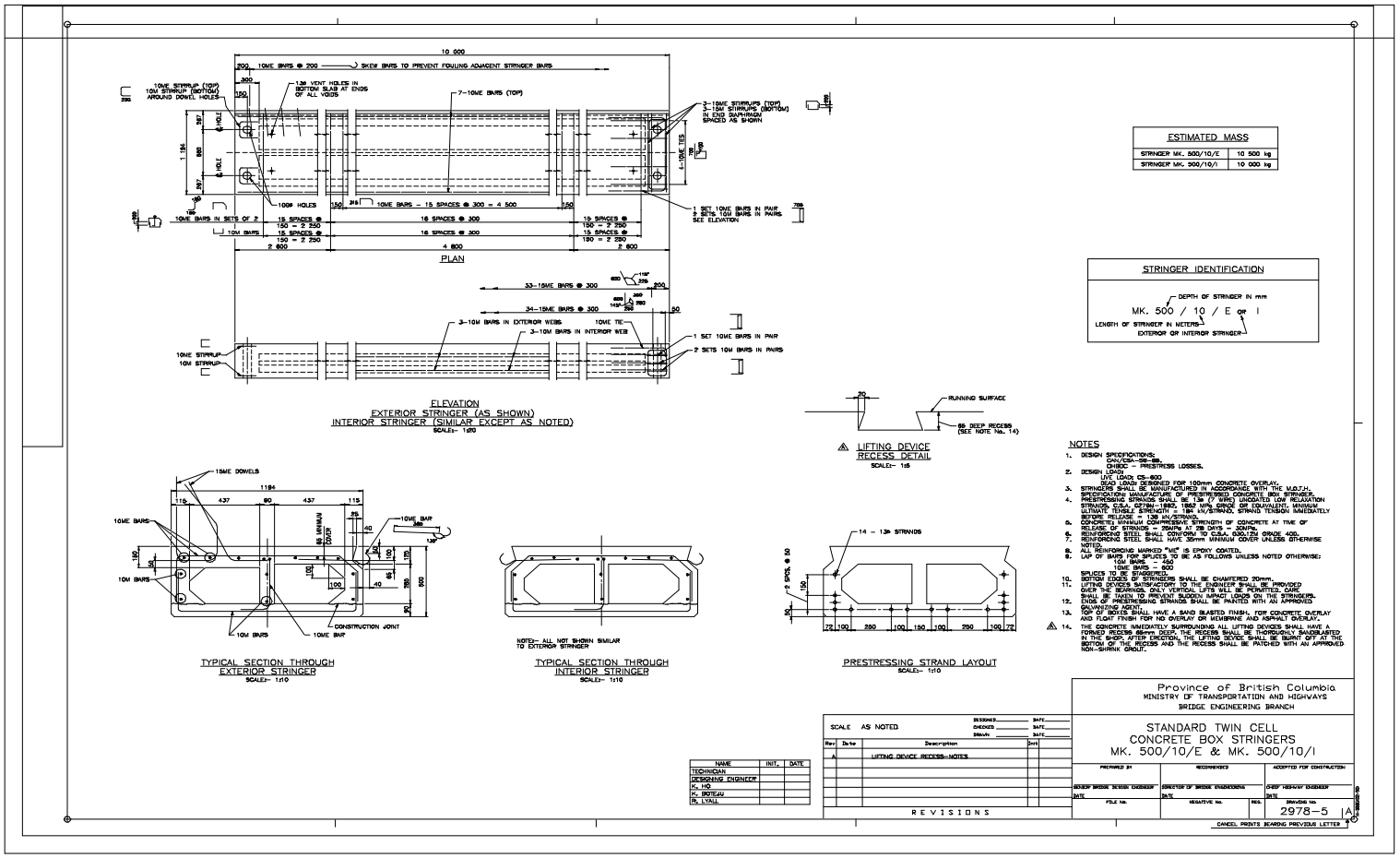

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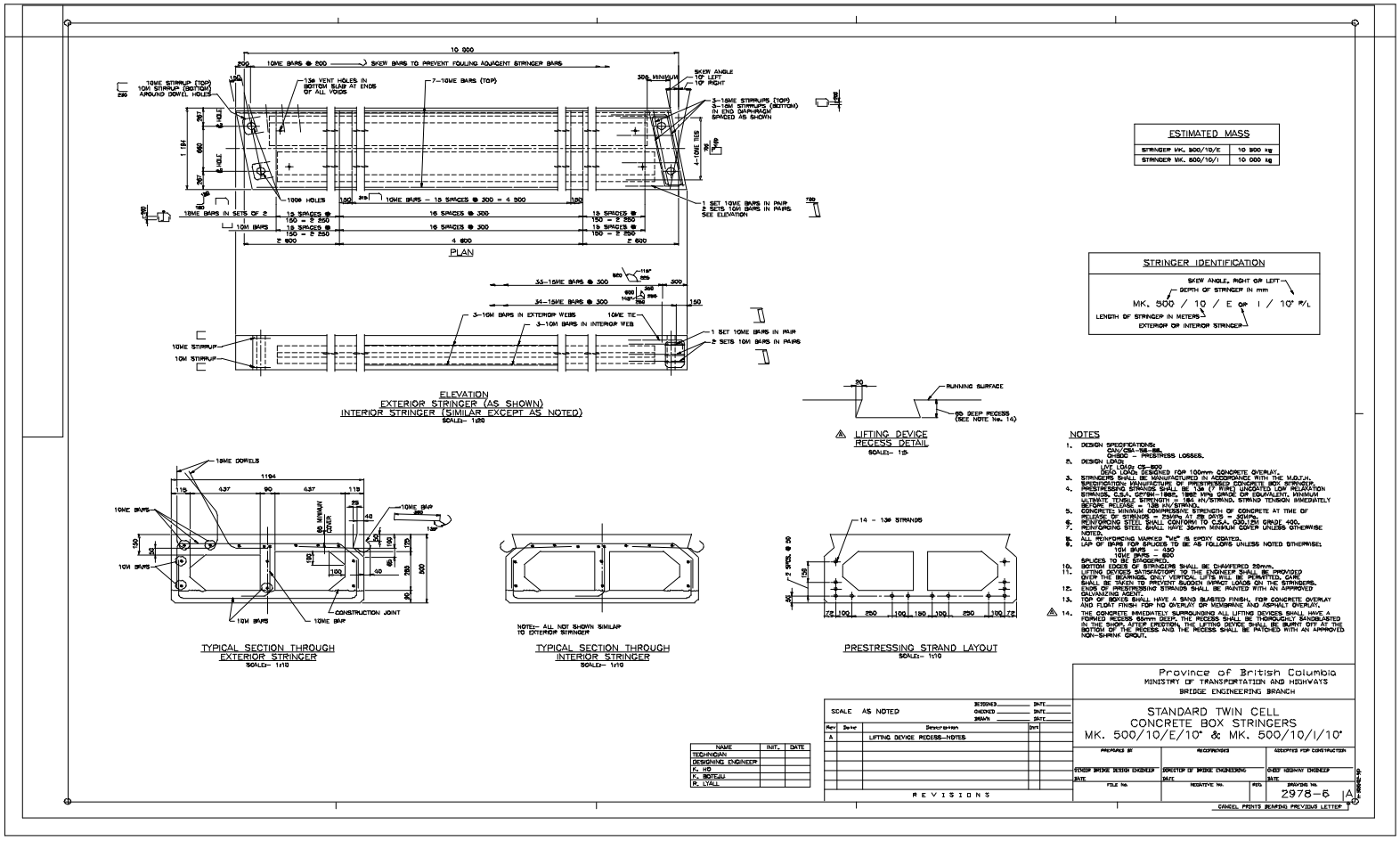

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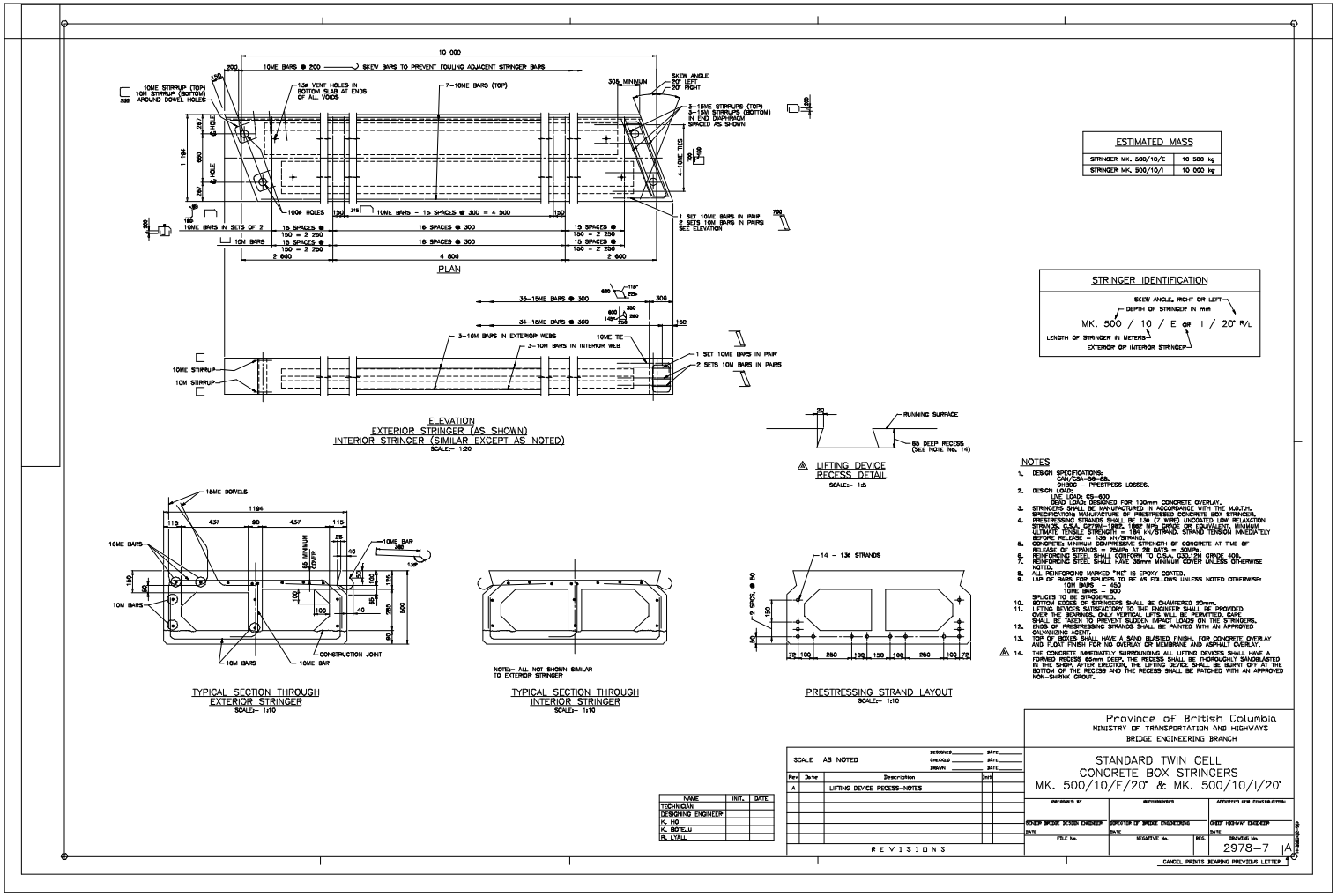

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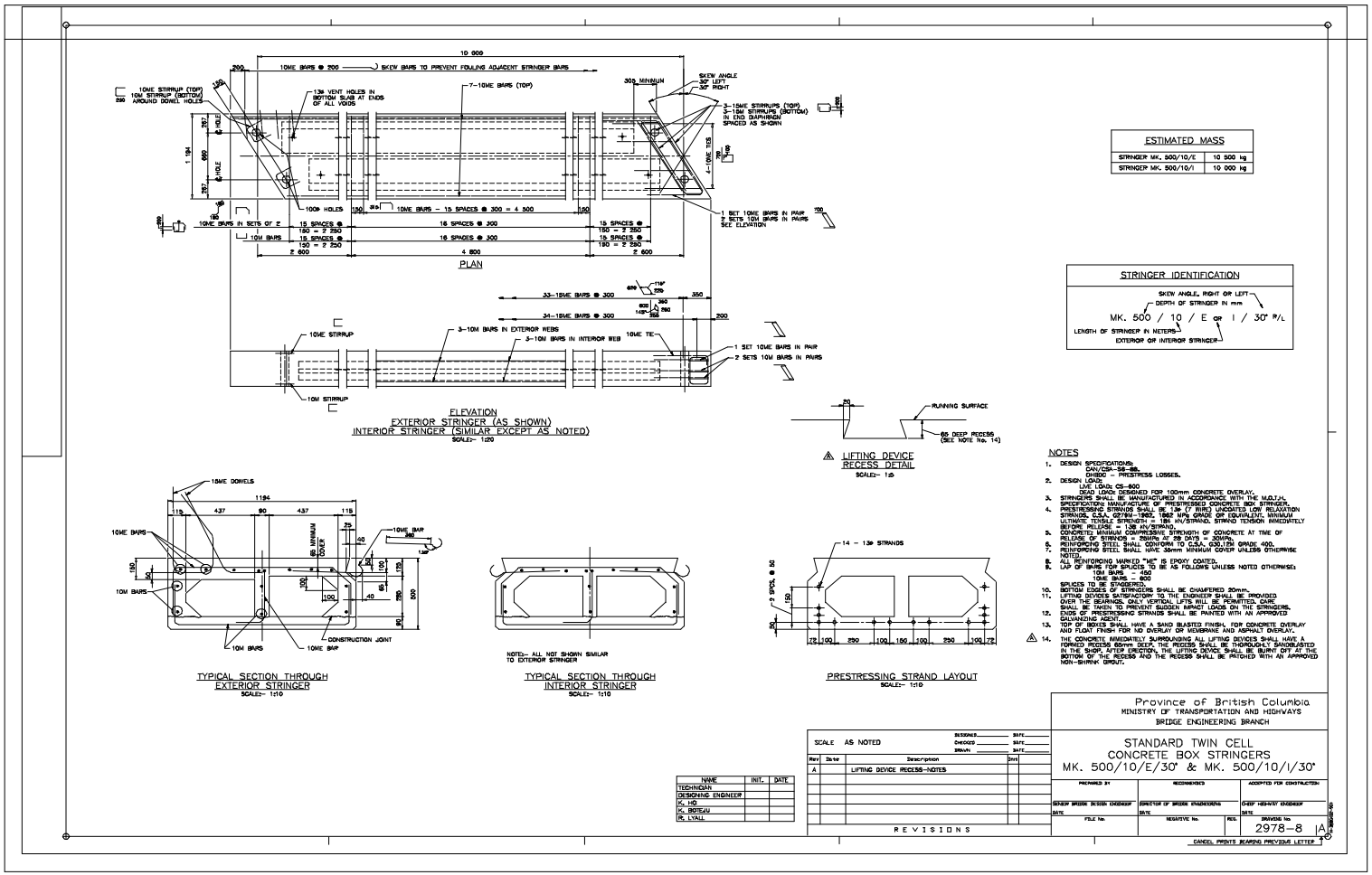

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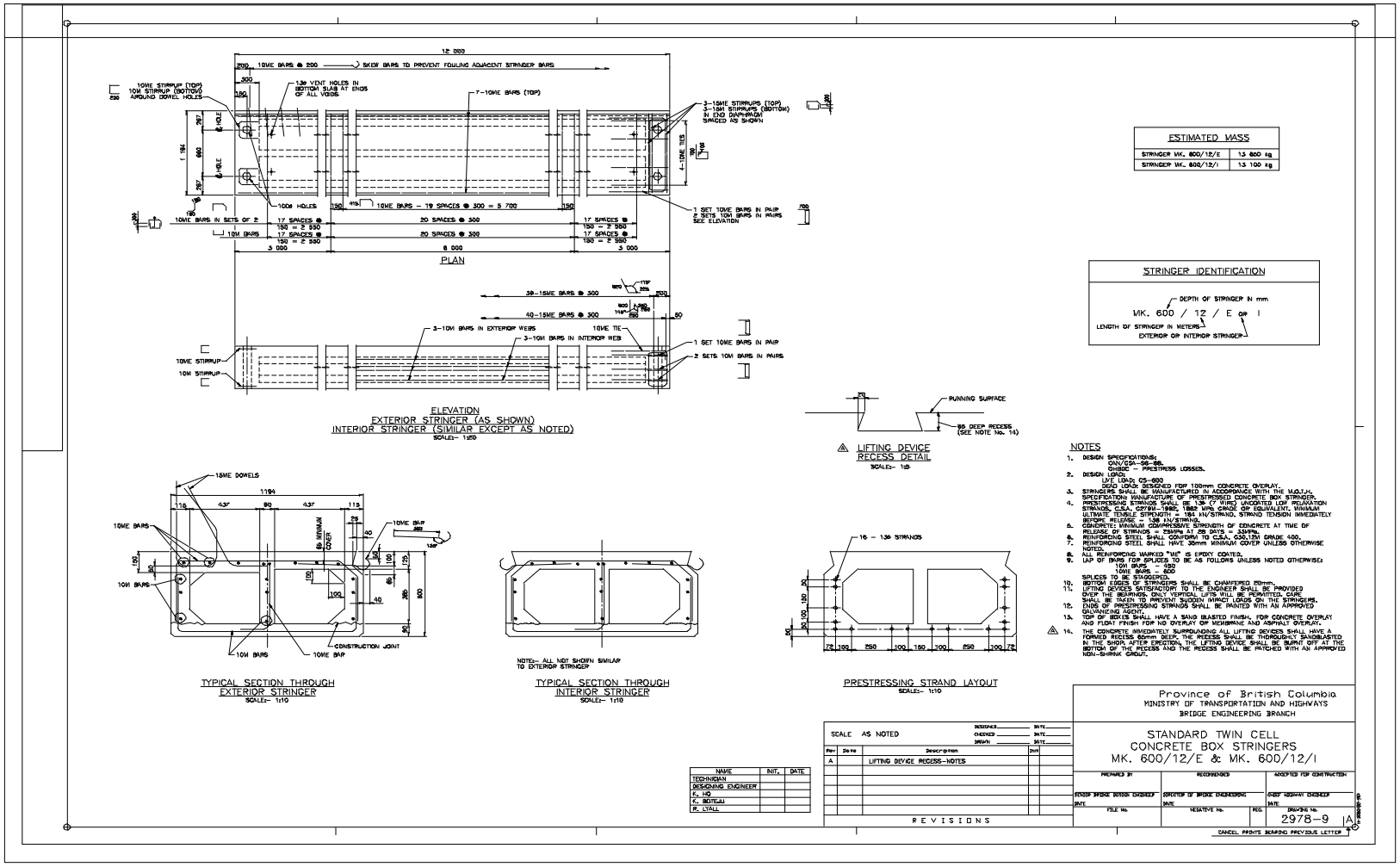

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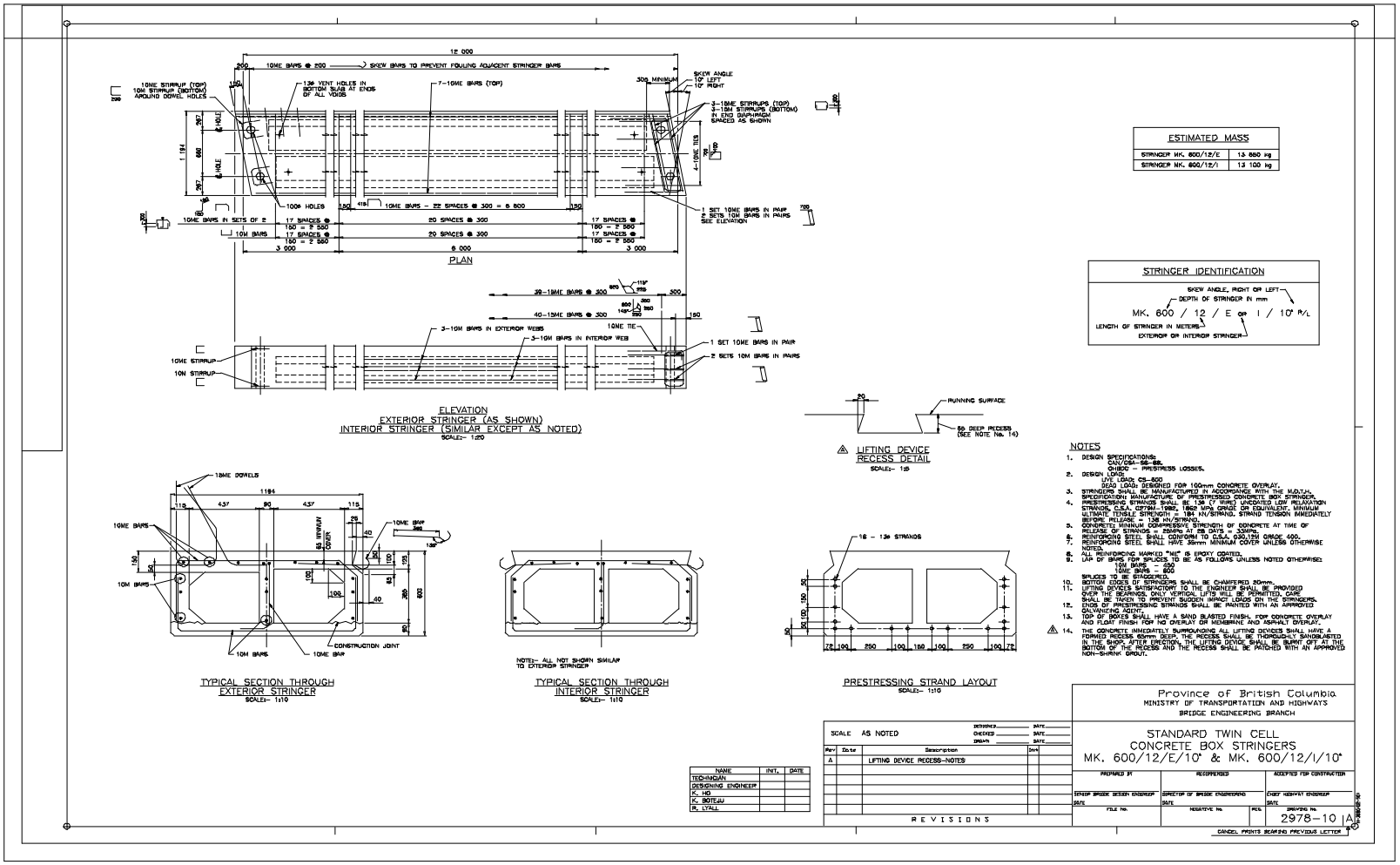

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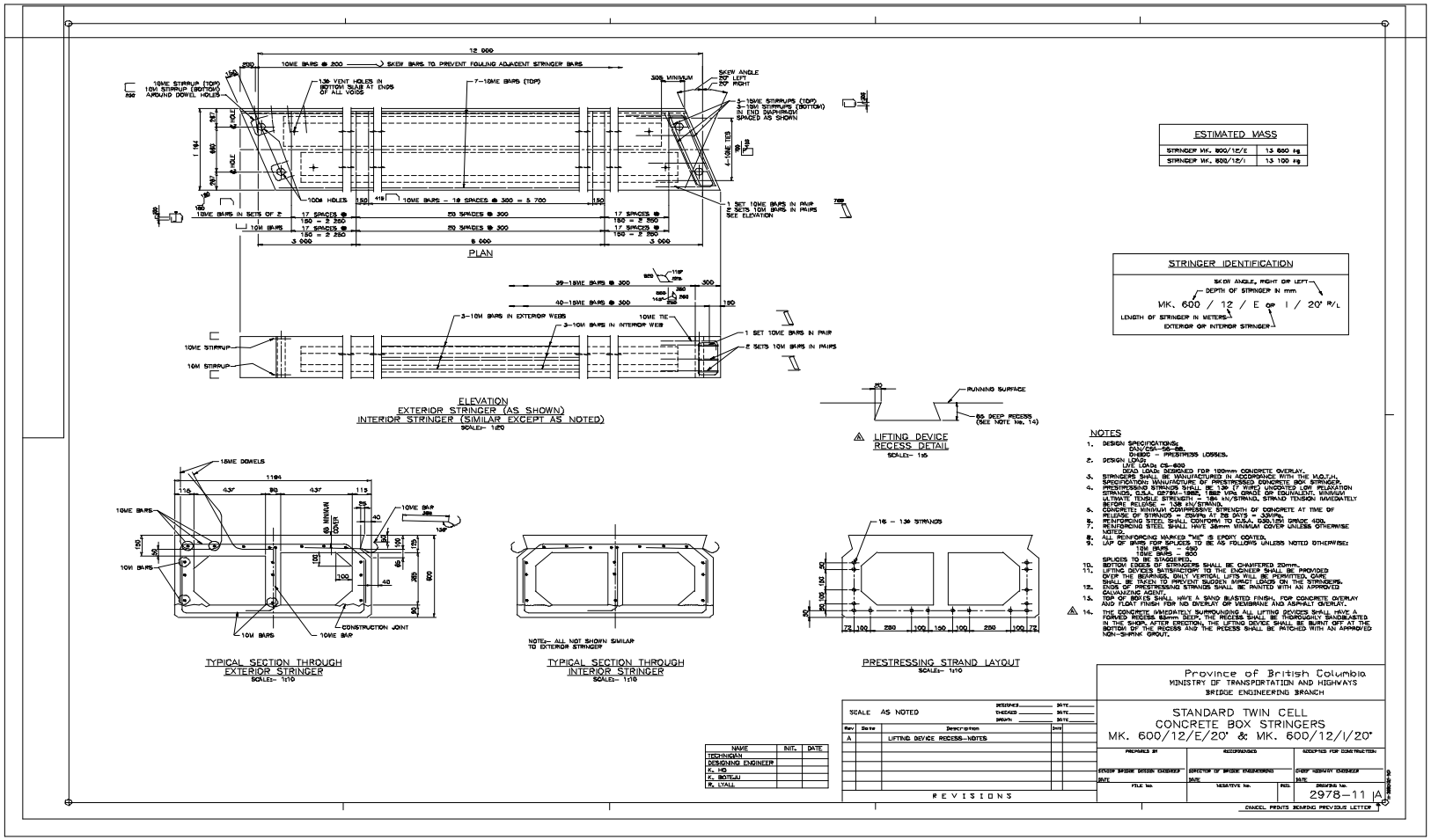

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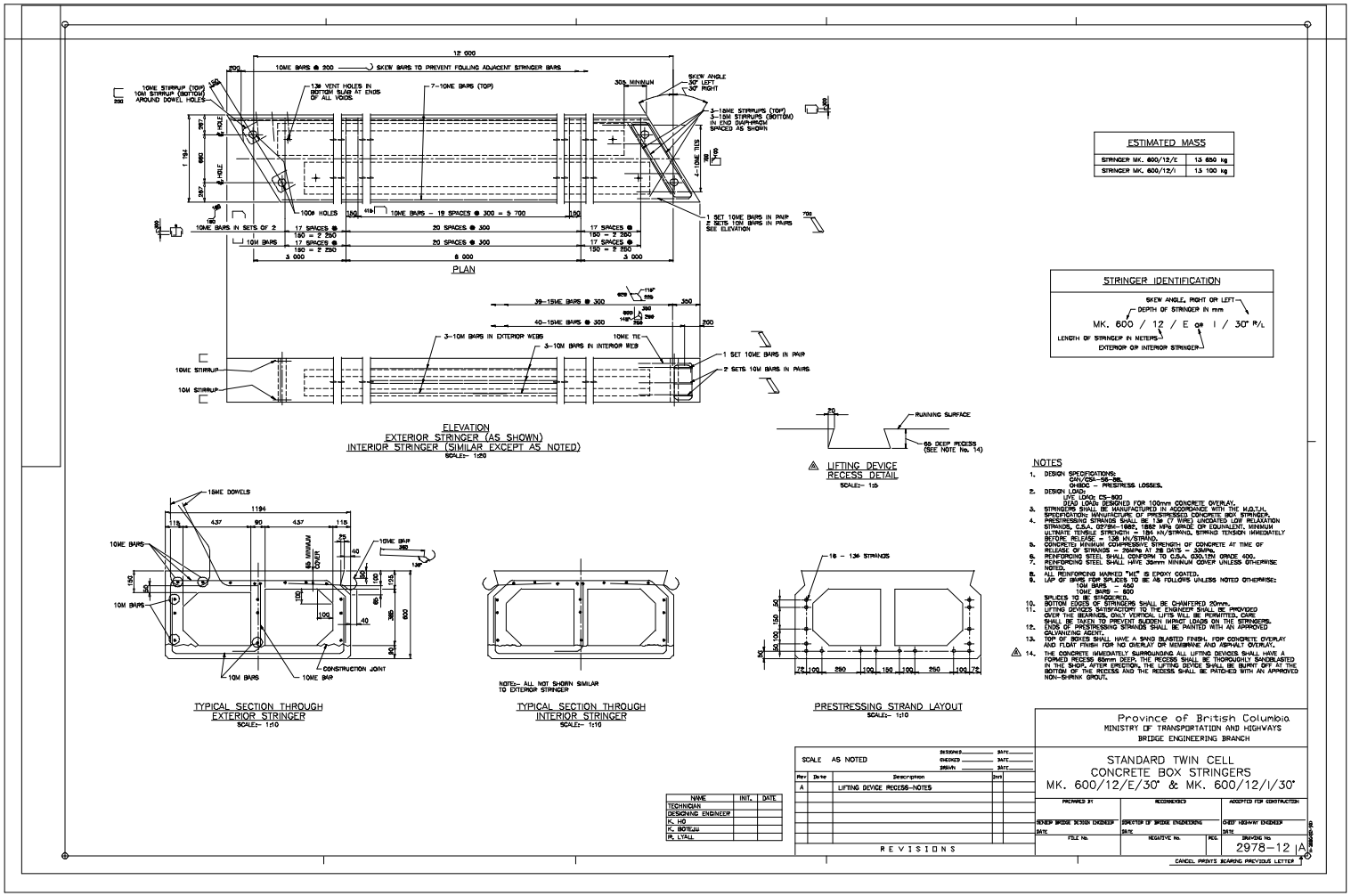

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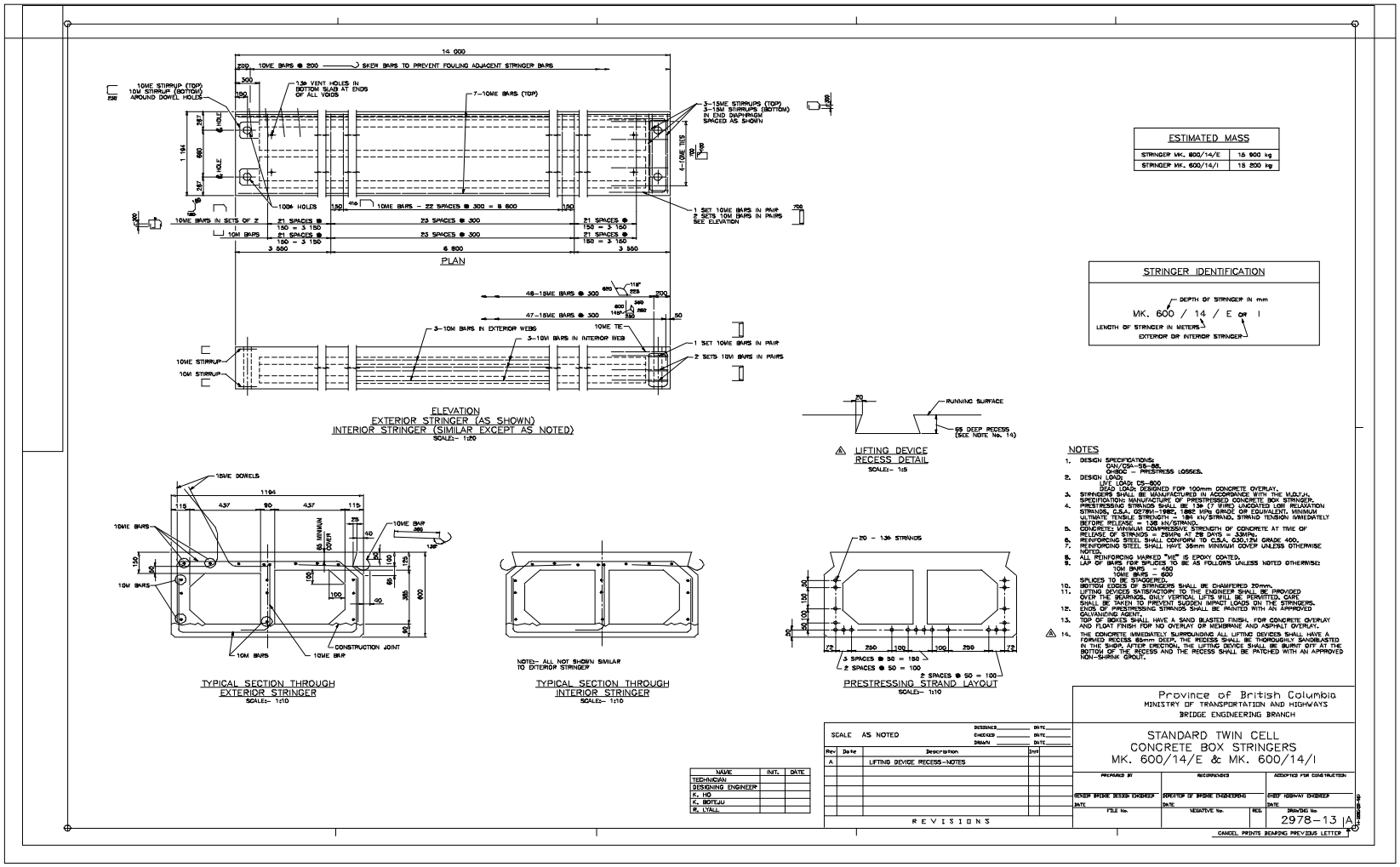

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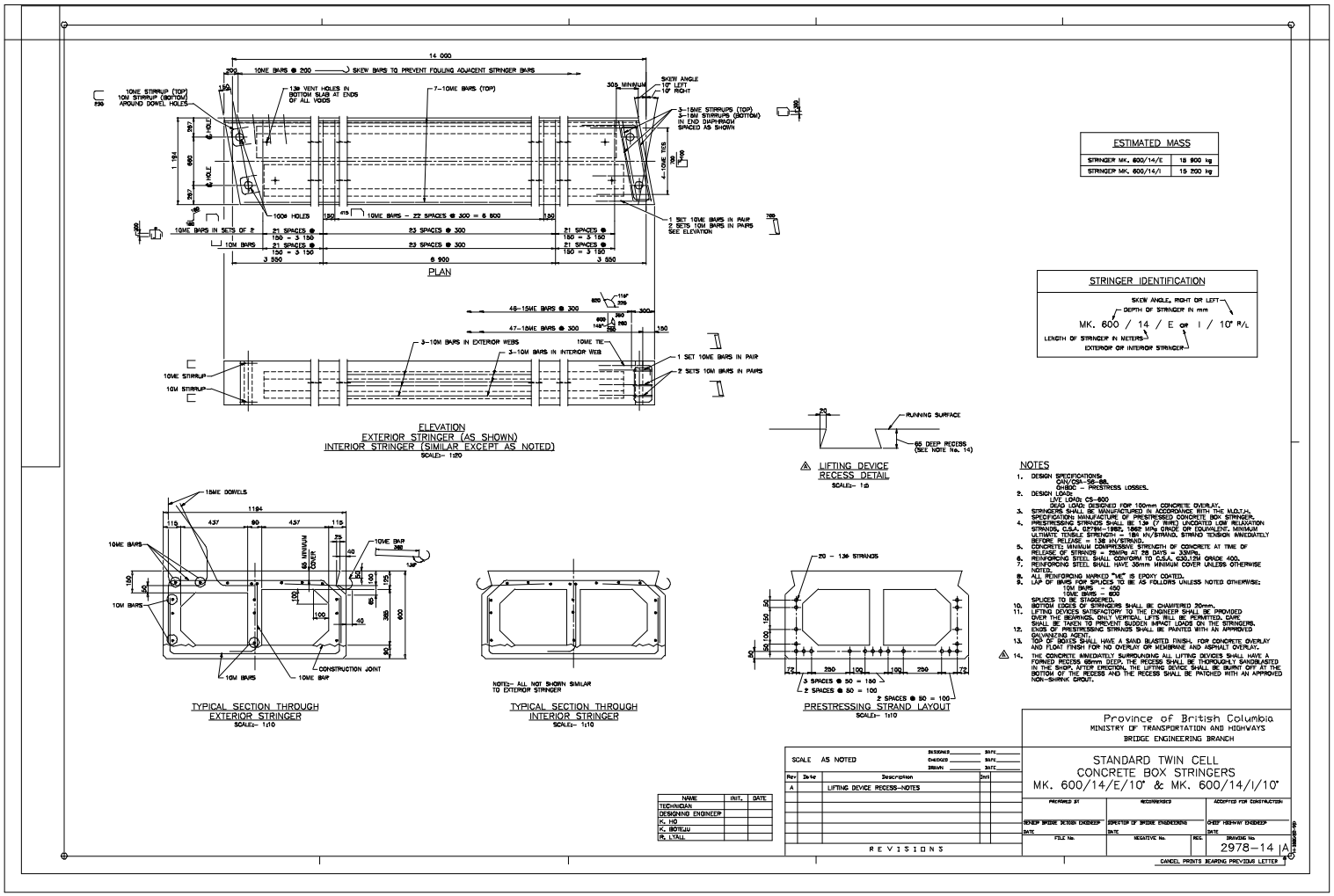

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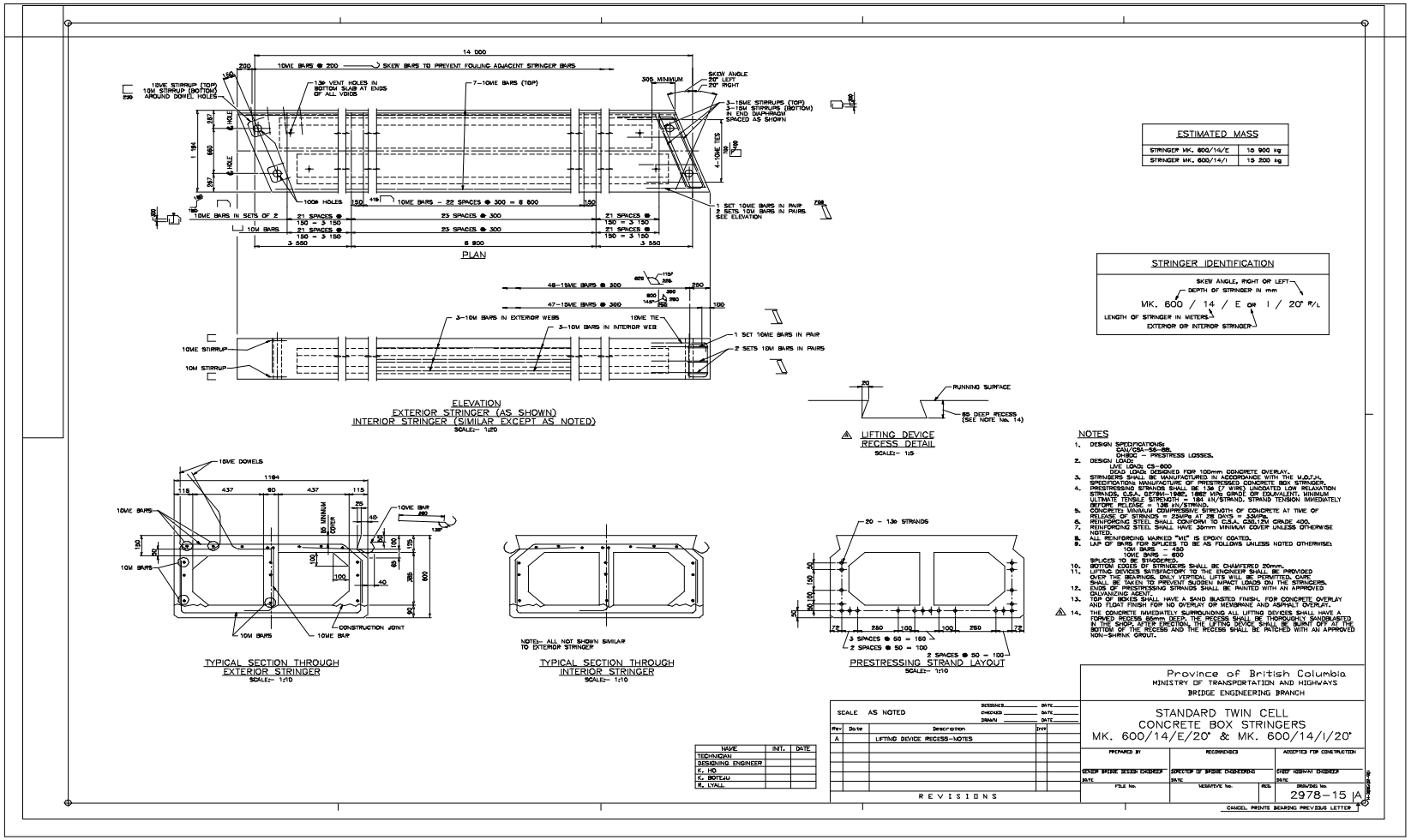

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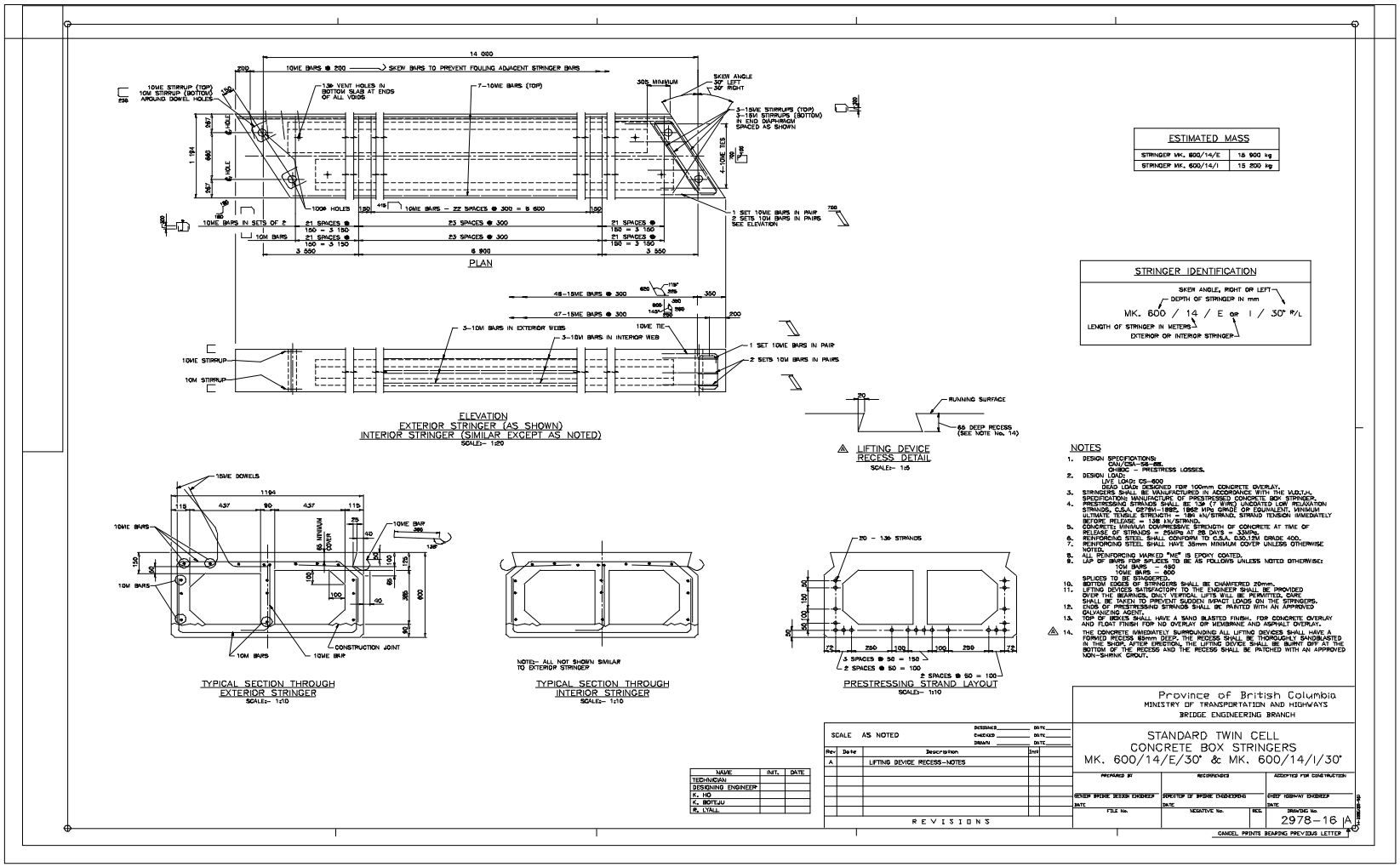

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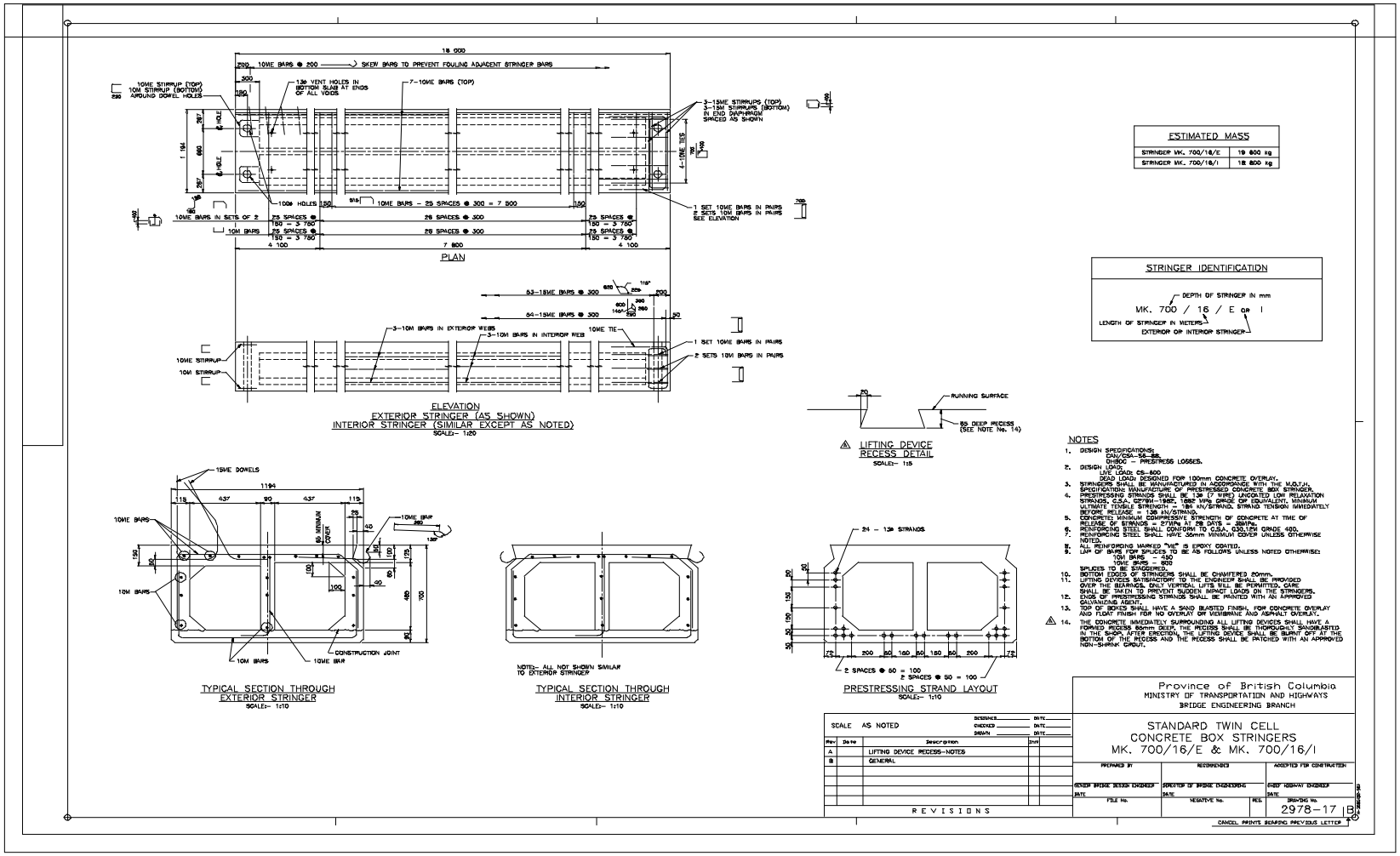

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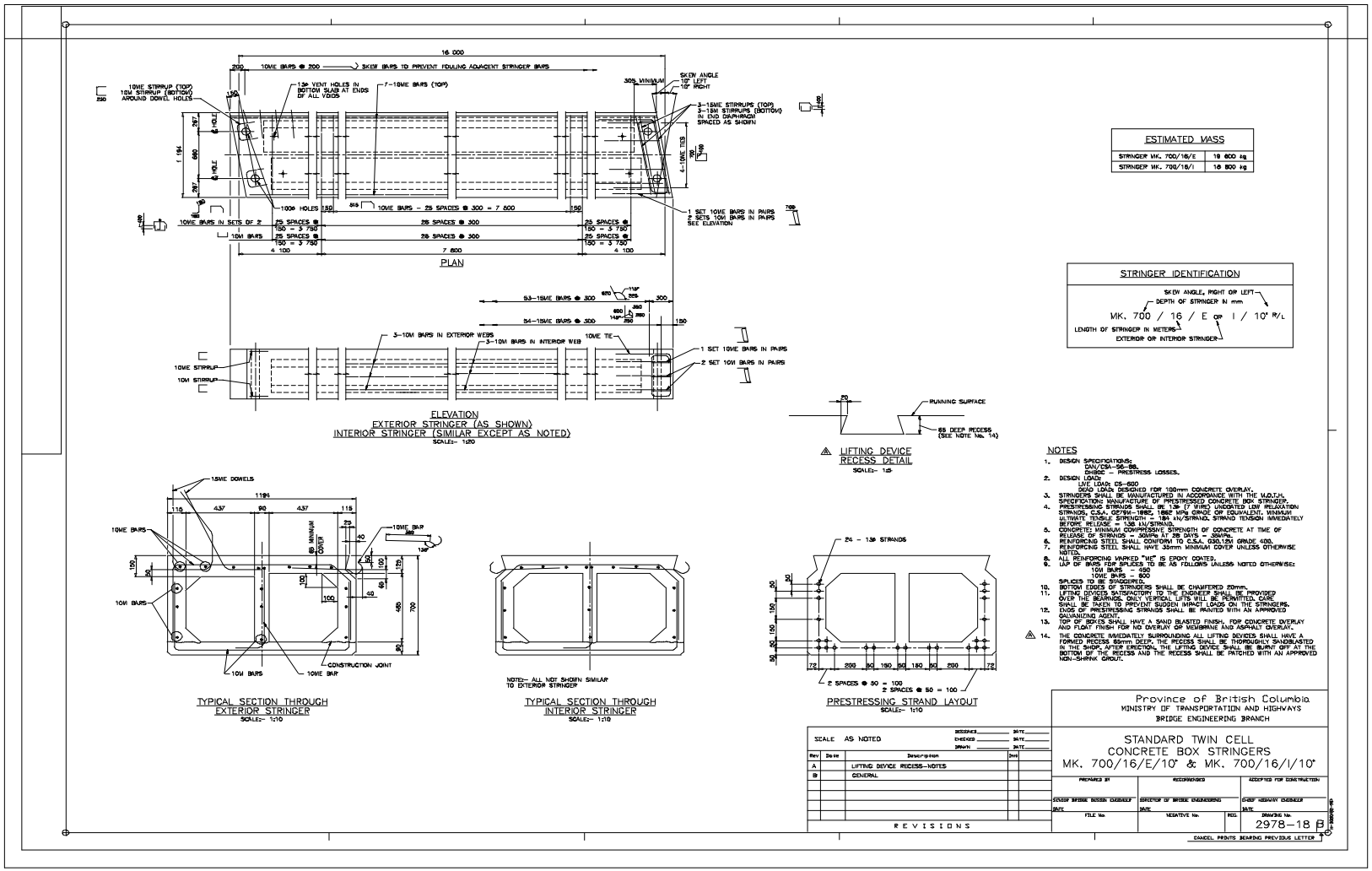

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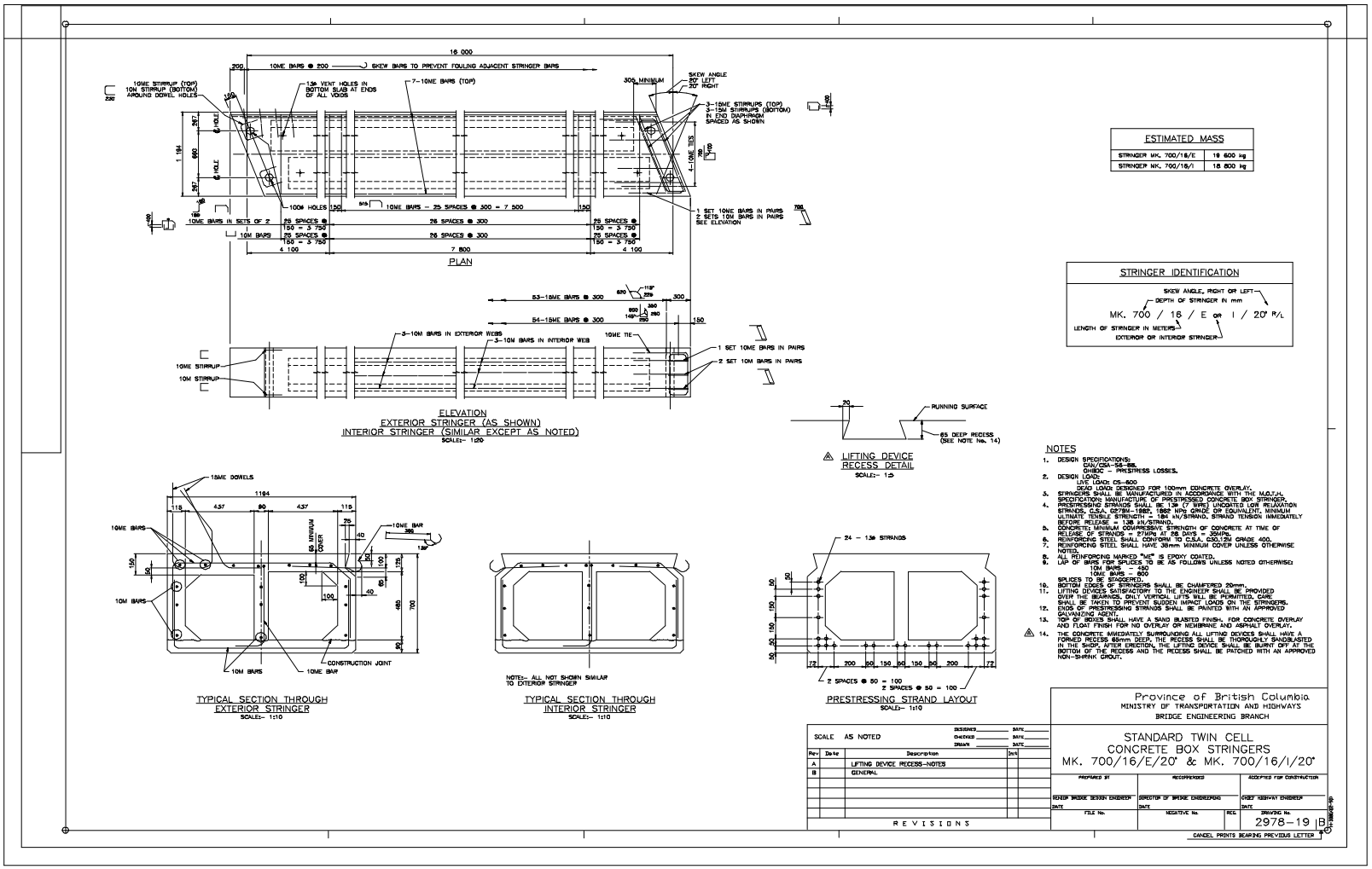

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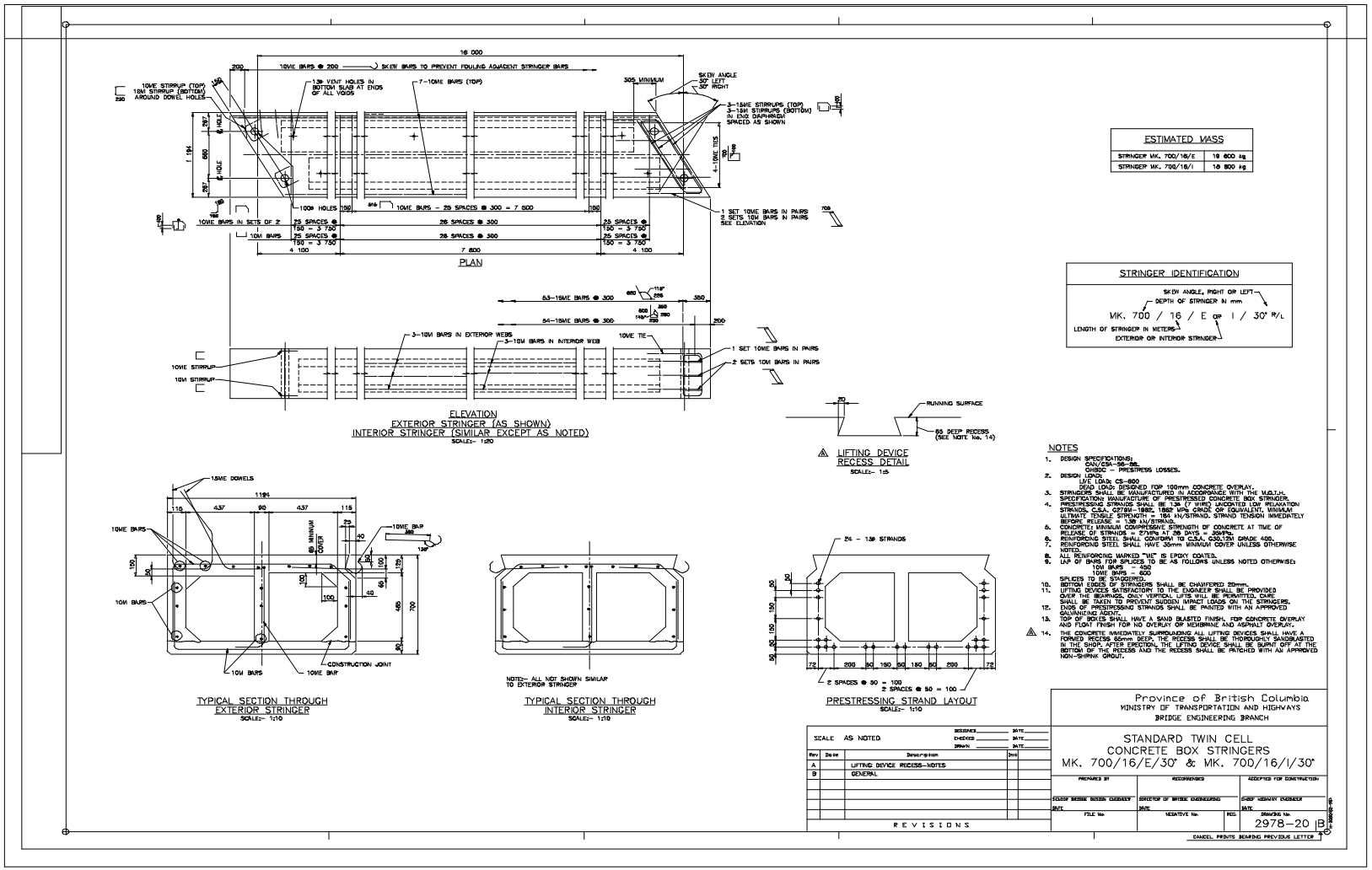

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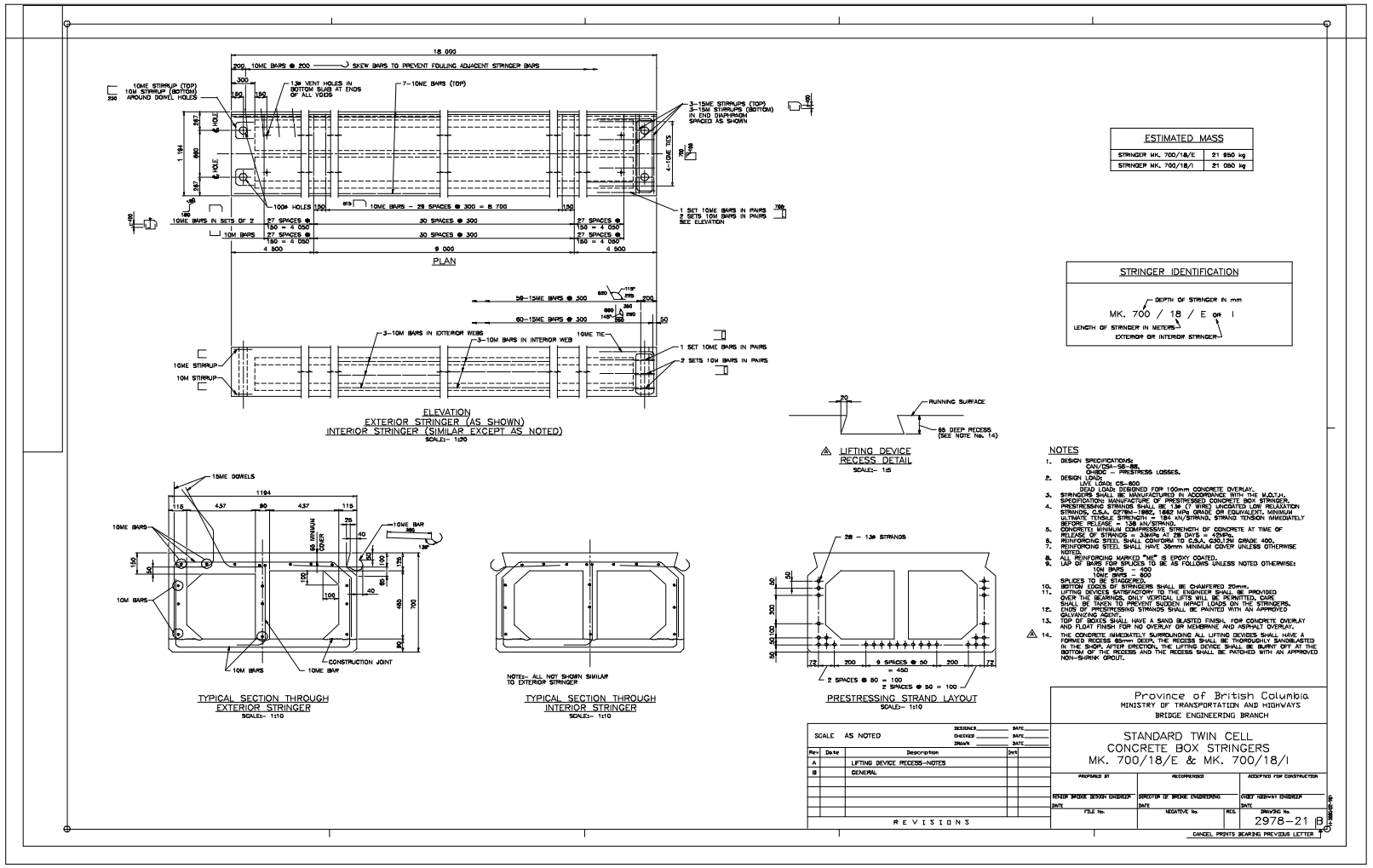

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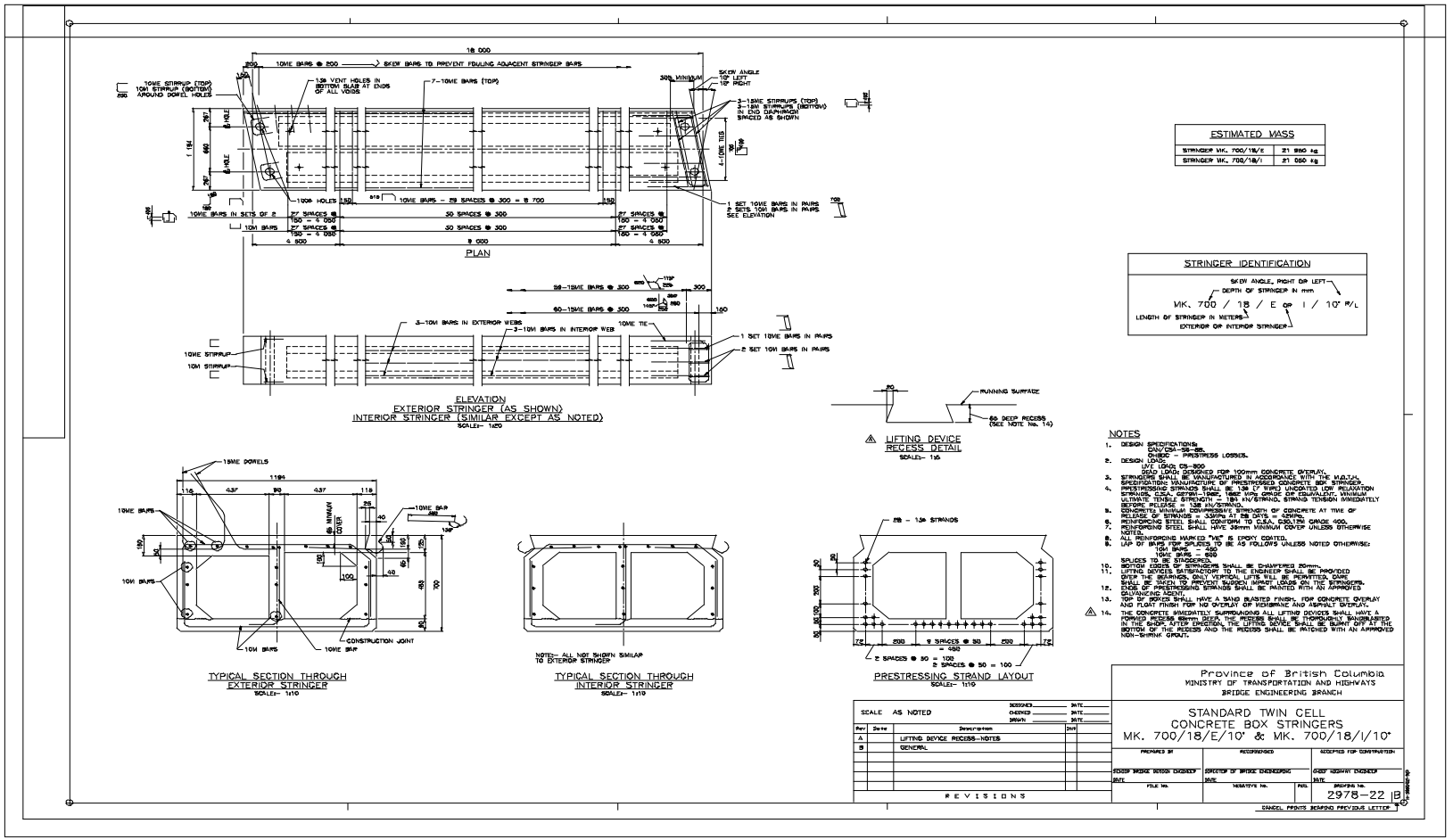

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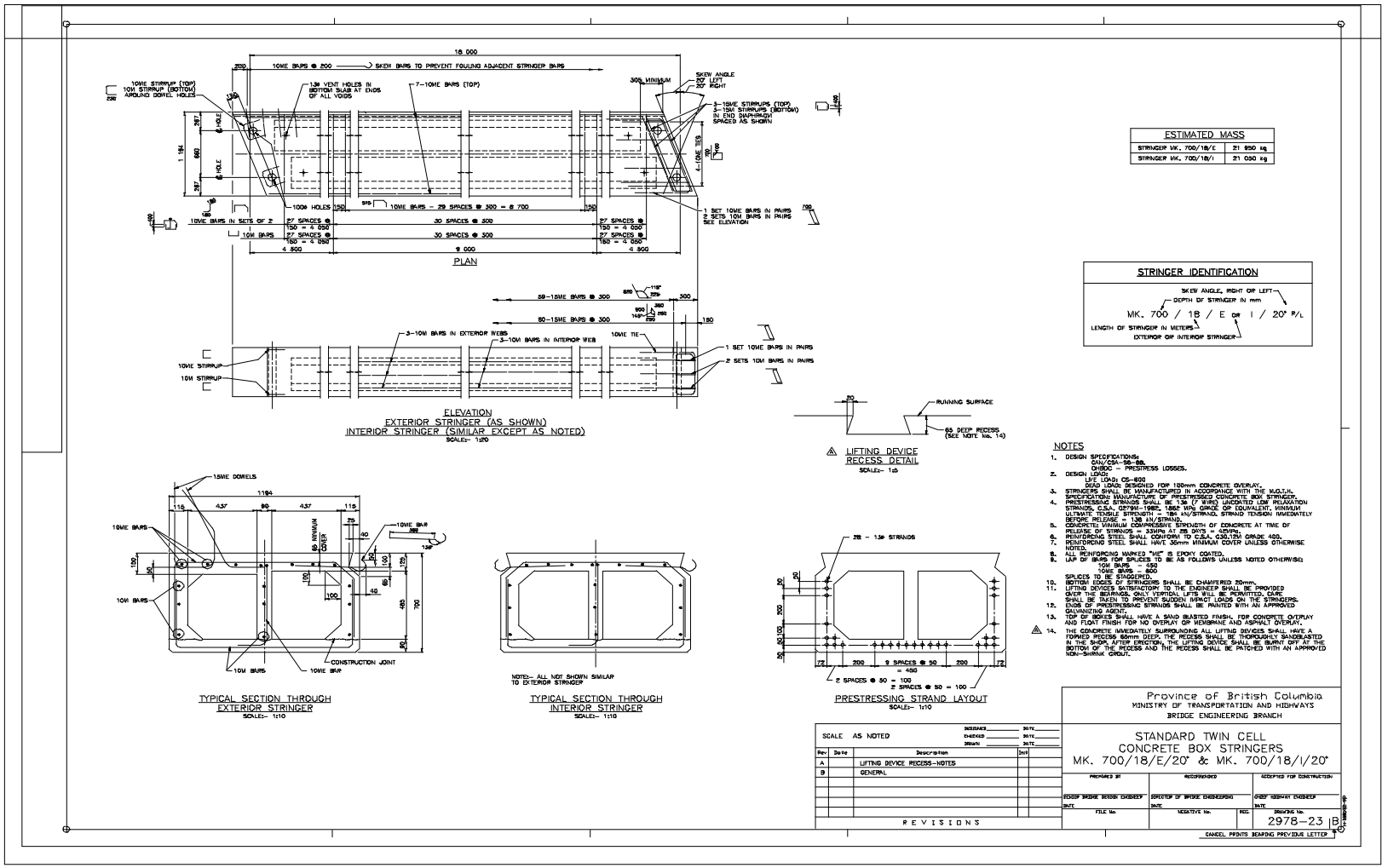

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