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Structural Design Aids

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1.0 PURPOSE

The purpose of this section is to provide the Entity-A/E the templates, checklists, design guidelines, etc. (collectively called Design Aids) to comprehensively define the Structural design of a Project and ensure that the design is complete, uses appropriate templates and has undergone the necessary checks to achieve the quality design which can be used to purchase fit for purpose material/ equipment and safely install all facilities under Entity's project.

Refer to Chapter 7, Section 1 - General Design Guideline (EPM-KE0-GL-000016) for the instructions on the use of every element of this Design Aids. Also refer Definitions and References (EPM-KE0-GL-000011) terms used on this document. This also covers non-discipline specific Design Aid such as Calculation Templates, Calculation check list, Design software list, etc. which apply to all engineering disciplines including Coastal Marine. Users are urged to carefully read the instructions provided in the above mentioned document to fully understand the purpose and use of all documents listed in this section.

The Entity-A/E shall review the list of deliverables and determine the templates, check lists, etc. applicable to the project. The list of applicable templates/ checklists/ etc. may vary from project to project depending upon the Design Scope of Work of the Project.

2.0 REFERENCE

1. EPM-KE0-GL-000016 - General Design Guideline
2. EPM-KES-GL-000001 - Structural Design Guideline
3. EPM-KES-RG-000001 - List of Structural Deliverables
4. EPM-KE0-GL-000011 - Definitions and References

3.0 STRUCTURAL DESIGN AIDS

The Structural Design Aids developed for use on Entity's projects are listed below, each issued as a standalone document.

3.1 Structural Design Guideline

Refer to the section on "Discipline design guidelines" in the document EPM-KE0-GL-000016 (General Design Guideline) for the purpose and the instructions on the use of discipline Design Guidelines issued for use in the design of Entity's Projects.

Refer to the Structural Design Guidelines EPM-KES-GL-000001 for additional details.

3.2 Structural Design Deliverables

Refer to the section on "Discipline deliverable lists" in the document EPM-KE0-GL-000016 (General Design Guideline) for the purpose and the instructions on the use of List of Design Deliverables issued for use in the design of Entity's projects.

Table below lists design deliverable issued for use on Entity's Projects.

List of Design Deliverable

SN	Template for	Document No.
1	List of Structural Deliverable	EPM-KES-RG-000001

3.3 Design Check Lists

Refer to the section on "Checklists" in the document EPM-KE0-GL-000016 (General Design Guideline) for the purpose and the instructions on the use of Checklists issued for the use in the design of Entity's projects.

Table below lists Structural check lists issued for use on Entity's Projects.

List of Structural Checklists

SN	Check List for	Document No
1	Pile Foundation Drawing	EPM-KES-TP-000001
2	Foundation Drawing	EPM-KES-TP-000002
3	Anchor Bolt & Base Plate Drawing	EPM-KES-TP-000003
4	Structural Steel Framing Plans	EPM-KES-TP-000004
5	Retaining Wall Drawing (Structural)	EPM-KES-TP-000005
6	Precast Elements Drawing	EPM-KES-TP-000006
7	Structural Steel Connections Drawing	EPM-KES-TP-000007
8	General Notes Drawing	EPM-KES-TP-000008

3.4 Templates

Refer to the section on "Templates" in the document EPM-KE0-GL-000016 (General Design Guideline) for the purpose and the instructions on the use of Templates issued for the use in the design of Entity's projects.

Table below lists Structural templates issued for use on Entity's Projects.

List of Structural Templates

SN	Template for	Document No.
1	Structural Design Criteria	EPM-KES-TP-000009

3.5 Typical Construction Detail Drawings (TCDDs)

Refer to the section on "Typical Construction Detail Drawing" in the document EPM-KE0-GL-000016 (General Design Guideline) for the purpose of TCDD in the design of Entity's projects.

Table below lists examples of Structural TCDD's issued as sample for use by Entity.

SN	Title of Drawing	Discipline	Drawing Number
1	Typical Footing Detail	Structural	EPM-KES-05-000001
2	Typical Beam Elevation and Section	Structural	EPM-KES-05-000002
3	Typical One-way Slab Detail	Structural	EPM-KES-05-000003
4	Metal Stairs	Structural	EPM-KES-05-000004
5	Concrete Cover Requirement	Structural	EPM-KES-05-000005

4.0 ATTACHMENTS

1. EPM-KES-TP-000001 - Checklist - Pile Foundation Drawing Template
2. EPM-KES-TP-000002 - Checklist - Foundation Drawing Template
3. EPM-KES-TP-000003 - Checklist - Anchor Bolt & Base Plate Drawing Template
4. EPM-KES-TP-000004 - Checklist - Structural Steel Framing Plans Template
5. EPM-KES-TP-000005 - Checklist - Retaining Wall Drawing (Structural) Template
6. EPM-KES-TP-000006 - Checklist - Precast Elements Drawing Template
7. EPM-KES-TP-000007 - Checklist - Structural Steel Connections Drawing Template
8. EPM-KES-TP-000008 - Checklist - General Notes Drawing Template

9. EPM-KES-TP-000009 - Structural Design Criteria Template
10. EPM-KES-RG-000001 - List of Structural Deliverables Template
11. EPM-KES-05-000001 - Drawing - Typical Footing Detail - Template
12. EPM-KES-05-000002 - Drawing - Typical Beam Elevation and Section - Template
13. EPM-KES-05-000003 - Drawing - Typical One-Way Slab Detail - Template
14. EPM-KES-05-000004 - Drawing - Metal Stairs - Template
15. EPM-KES-05-000005 - Drawing -Concrete Cover Requirement - Template
16. EPM-KES-TP-000011 - Checklist - Transportation Structure GA Drawing Template

Attachment 1 - EPM-KES-TP-000001 - Checklist - Pile Foundation Drawing-Template

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PROJECT NAME:	DRAWING NO.	REV.

No.	QUESTIONS	ORIGINATOR			CHECKER		
		N/A	YES	NO	N/A	YES	NO
Preparation and Checking							
01	Does the drawing comply with applicable codes, standards and regulatory requirements?	☐	☐	☐	☐	☐	☐
02	Does the drawing comply with applicable Project Design Criteria, system or structural functional requirements, Scope Book, and Design Basis Documents considered?	☐	☐	☐	☐	☐	☐
03	Is the coordinate system and site direction (North) on drawing correct?	☐	☐	☐	☐	☐	☐
04	Does the drawing include coordinates of piles matching project coordinate system?	☐	☐	☐	☐	☐	☐
05	Does the specified compressive strength of concrete piles comply with Project Specifications?	☐	☐	☐	☐	☐	☐
06	Does the specified grade of reinforcement comply with Project Specifications?	☐	☐	☐	☐	☐	☐
07	Does splice length for tension rebars and anchorage length comply with Code?	☐	☐	☐	☐	☐	☐
08	Have the dowel lengths of rebar's been checked with code?	☐	☐	☐	☐	☐	☐
09	Do concrete covers comply with Project Specifications?	☐	☐	☐	☐	☐	☐
10	Does the concrete coating/protection system comply with Project Specifications?	☐	☐	☐	☐	☐	☐
11	Does the steel coating/protection system comply with Project Specifications?	☐	☐	☐	☐	☐	☐
12	Does vertical angle or slope of batter piles comply with Project Standards?	☐	☐	☐	☐	☐	☐
13	Does minimum distance between piles comply with code/Geotechnical recommendations?	☐	☐	☐	☐	☐	☐
14	Does drawing specify test loads including pile test arrangement?	☐	☐	☐	☐	☐	☐
15	Does the grade of structural steel comply with Project Specifications?	☐	☐	☐	☐	☐	☐
16	Does the drawing include profile, size, diameter, wall thickness etc. for piles?	☐	☐	☐	☐	☐	☐
17	Does the drawing include external/internal shear keys for steel piles?	☐	☐	☐	☐	☐	☐
18	Have the cut off levels of steel piles been checked with general arrangement drawings?	☐	☐	☐	☐	☐	☐
19	Does the drawing include steel diaphragm detail for pile plug connection?	☐	☐	☐	☐	☐	☐
20	Does the drawing contain pile schedule including toe level, top level, length of pile, quantities of piles, diameter of pile and batter angle of pile?	☐	☐	☐	☐	☐	☐
21	Does the drawing include scour protection detail?	☐	☐	☐	☐	☐	☐
22	Does the welding connection between piles comply with code?	☐	☐	☐	☐	☐	☐
23	Have the design parameters like embedded length, diameter of pile, type of fixity (i.e. pin or fixed) wall thickness been validated with calculations report?	☐	☐	☐	☐	☐	☐
24	Does pile layout drawing mentions pile type (e.g. CIP, Pre-cast, Steel, Wood), length, cut-off elevation, requirement of tension connectors?	☐	☐	☐	☐	☐	☐
25	Has criteria for (a) pile driving, (b) pile refusal and (c) load tests been defined on the drawing?	☐	☐	☐	☐	☐	☐
26	Has each type of pile been designed structurally and are the pile design forces less than the minimum of structural strength and soil strength?	☐	☐	☐	☐	☐	☐
Co-related Documents							
27	Has reference of list of drawings been provided?	☐	☐	☐	☐	☐	☐

Attachment 2 - EPM-KES-TP-000002 - Checklist - Foundation Drawing – Template

PROJECT NAME:	DRAWING NO.	REV.

No.	QUESTIONS	ORIGINATOR			CHECKER		
		N/A	YES	NO	N/A	YES	NO
Preparation and Checking							
01	Does the drawing comply with applicable codes, standards and regulatory requirements?	☐	☐	☐	☐	☐	☐
02	Does the drawing comply with applicable project design criteria, system or structural functional requirements, Scope Book, and Design basis documents considered?	☐	☐	☐	☐	☐	☐
03	Is the coordinate system and the site arrow direction (Mecca) on drawing correct?	☐	☐	☐	☐	☐	☐
04	Does the Allowable Bearing Capacity (ABC) and settlement on the drawing comply with geotechnical report?	☐	☐	☐	☐	☐	☐
05	Does drawing specify the footing schedule of all foundations?	☐	☐	☐	☐	☐	☐
06	Does footing schedule specify the sizes, depths, foundation levels as a minimum?	☐	☐	☐	☐	☐	☐
07	Does concrete cover to reinforcement comply with Project specifications?	☐	☐	☐	☐	☐	☐
08	Does the specified compressive strength of in-situ & precast concrete in foundations comply with project Specifications?	☐	☐	☐	☐	☐	☐
09	Does the specified compressive strength of concrete in grade beams comply with project Specifications?	☐	☐	☐	☐	☐	☐
10	Does the specified compressive strength of blinding concrete comply with project Specifications?	☐	☐	☐	☐	☐	☐
11	Does the specified compressive strength of non-shrink grout comply with project Specifications?	☐	☐	☐	☐	☐	☐
12	Does the specified compressive strength of screed comply with project Specifications?	☐	☐	☐	☐	☐	☐
13	Does the grade of Reinforcement steel comply with project Specifications?	☐	☐	☐	☐	☐	☐
14	Does the drawing specify a note for the separation of two dissimilar metals to avoid corrosion?	☐	☐	☐	☐	☐	☐
15	Does the splice length of tension splice comply with Project specifications?	☐	☐	☐	☐	☐	☐
16	Does the dowel length (of rebars) for the column include an allowance for kicker?	☐	☐	☐	☐	☐	☐
17	Has the clash between column rebars, supplementary reinforcement and anchor bolts been checked?	☐	☐	☐	☐	☐	☐
18	Have the foundation been checked for the openings/penetrations/pockets due to MEP?	☐	☐	☐	☐	☐	☐
19	Does the concrete coating/protection system comply with Project Specifications?	☐	☐	☐	☐	☐	☐
20	Has the clash between foundations and embedded pits been done?	☐	☐	☐	☐	☐	☐
21	Has the location/coordinates of embeds (anchor bolts, steel plates, sections etc.) been checked with other disciplines drawings?	☐	☐	☐	☐	☐	☐
22	Has the congestion of reinforcement at the junction of plinth beam and column been checked?	☐	☐	☐	☐	☐	☐
23	Does the backfill around the structure comply with Project specification?	☐	☐	☐	☐	☐	☐
24	If applicable, has the dewatering note been included?	☐	☐	☐	☐	☐	☐
25	Has the drawing been checked for "Holds"?	☐	☐	☐	☐	☐	☐
26	Does the Foundation Plan and Elevations show adjacent foundations or structures those require right construction sequence to avoid undermining, shoring or risk to adjacent foundation/structures?	☐	☐	☐	☐	☐	☐
27	Is there a reference on curing process to be followed?	☐	☐	☐	☐	☐	☐
Co-related Documents							

Attachment 3 - EPM-KES-TP-000003 - Checklist - Anchor Bolt & Base Plate Drawing – Template

PROJECT NAME:	DRAWING NO.	REV.

No.	QUESTIONS	ORIGINATOR			CHECKER		
		N/A	YES	NO	N/A	YES	NO
Preparation and Checking							
01	Does the drawing comply with applicable codes, standards and regulatory requirements?	☐	☐	☐	☐	☐	☐
02	Does the drawing comply with applicable project design criteria, system or structural functional requirements, Scope Book, and Design basis documents considered?	☐	☐	☐	☐	☐	☐
03	Does the specified compressive strength (28-day) of concrete comply with project Specifications?	☐	☐	☐	☐	☐	☐
04	Does the specified compressive strength of Non- shrink grout comply with project Specifications?	☐	☐	☐	☐	☐	☐
05	Does the grade of base plates comply with project Specifications?	☐	☐	☐	☐	☐	☐
06	Does the grade of anchor bolt comply with project Specifications?	☐	☐	☐	☐	☐	☐
07	Are grade, type and diameter of anchor bolt (e.g. galvanized, etc.) shown on the drawing?	☐	☐	☐	☐	☐	☐
08	Does embedded depth of anchor bolts comply with codes?	☐	☐	☐	☐	☐	☐
09	Does side/bottom cover to anchor bolt comply with project specifications and code?	☐	☐	☐	☐	☐	☐
10	Has the clash between anchor bolts and reinforcement been checked?	☐	☐	☐	☐	☐	☐
11	Have all anchor bolts been checked that they are inside the reinforcement cage?	☐	☐	☐	☐	☐	☐
12	Does grade of anchor bars/embedded plates comply with project specification?	☐	☐	☐	☐	☐	☐
13	Does concrete cover of embedded/anchor base plate comply with project specifications and code?	☐	☐	☐	☐	☐	☐
14	Is thickness of grout adequate?	☐	☐	☐	☐	☐	☐
15	Is the projection length of anchor bolt above the concrete adequate for two nuts including washer, when required by design or standard detail?	☐	☐	☐	☐	☐	☐
16	Does the type and grade of nuts comply with project specifications?	☐	☐	☐	☐	☐	☐
17	Does the anchor bolt hole size in base plate comply with code?	☐	☐	☐	☐	☐	☐
18	Have the edge distances in base plate been checked with code?	☐	☐	☐	☐	☐	☐
19	Does the center to center distance between anchor bolts comply with code?	☐	☐	☐	☐	☐	☐
20	Has the clash between steel column and nut been checked?	☐	☐	☐	☐	☐	☐
21	Have two dissimilar metals been isolated to avoid corrosion due to galvanic action?	☐	☐	☐	☐	☐	☐
22	Has the corrosion allowance been considered for anchor bolts, when required by design?	☐	☐	☐	☐	☐	☐
23	Does anchor bolt validate the calculations submitted for each type, grade and diameter of anchor bolt?	☐	☐	☐	☐	☐	☐
24	Does base plate validate the calculations submitted for each type, grade & diameter of anchor bolt?	☐	☐	☐	☐	☐	☐
25	Does the base plate with moment connection reflect the correct arrangement of anchor bolts and shear lug, if required, in calculation report?	☐	☐	☐	☐	☐	☐
26	Does the base plate with shear connection (pin support) reflect the correct arrangement of anchor bolts in calculation report?	☐	☐	☐	☐	☐	☐
Co-related Documents							
27	Has reference of the list of drawings been provided?	☐	☐	☐	☐	☐	☐
28	Has the reference of general notes drawing been provided?	☐	☐	☐	☐	☐	☐
29	Has the reference of framing plan drawing been provided?	☐	☐	☐	☐	☐	☐
Coordination and Review							

Attachment 4 - EPM-KES-TP-000004 - Checklist - Structural Steel Framing Plans Drawing – Template

PROJECT NAME:		DRAWING NO.			REV.		
No.	QUESTIONS	ORIGINATOR			CHECKER		
		N/A	YES	NO	N/A	YES	NO
Preparation and Checking							
01	Does the drawing comply with applicable codes, standards and regulatory requirements?	☐	☐	☐	☐	☐	☐
02	Does the drawing comply with applicable project design criteria, system or structural functional requirements, Scope Book, and Design basis documents considered?	☐	☐	☐	☐	☐	☐
03	Have the shown structural steel framing plans/sections with indicated steel member sizes supported by the design calculations/structural analysis, which demonstrates the structural adequacy to resist the applicable design loads within the specified allowable limits, been met?	☐	☐	☐	☐	☐	☐
04	Have structural steel framing plans provided at each level of building?	☐	☐	☐	☐	☐	☐
05	Does the level on each structural framing/floor plan match with architectural Plan drawings?	☐	☐	☐	☐	☐	☐
06	Have the structural plans/views captured the other disciplines requirements?	☐	☐	☐	☐	☐	☐
07	Has clash of structural steel members been checked for MEP services/openings/recesses?	☐	☐	☐	☐	☐	☐
08	Has the effect of MEP openings/slots been considered in the design?	☐	☐	☐	☐	☐	☐
09	Are the weights of secondary steel (additional steel required for cladding and MEP services etc.) and fireproofed steel members considered in design?	☐	☐	☐	☐	☐	☐
10	What was a design margin adopted when no vendor info is available or Not-To-Exceed loads were defined?	☐	☐	☐	☐	☐	☐
11	Have equipment & construction loads on roof considered in design?	☐	☐	☐	☐	☐	☐
12	Has accumulation weight of sand above roof considered in design?	☐	☐	☐	☐	☐	☐
13	Have weights of electrical and mechanical services hangings from ceiling, considered in design?	☐	☐	☐	☐	☐	☐
14	Has weight of PV panels on roof considered in design?	☐	☐	☐	☐	☐	☐
15	Has effect of temperature during construction stage (without cladding) considered in design?	☐	☐	☐	☐	☐	☐
16	Has additional reinforcement or additional structural steel been provided around the openings, in composite deck slab?	☐	☐	☐	☐	☐	☐
17	Do the splice lengths of rebar in composite deck slab comply with code?	☐	☐	☐	☐	☐	☐
18	Do steel framing plans and sections show the type of connection (moment or shear)?	☐	☐	☐	☐	☐	☐
19	Do connections, clearly shown on the framing plans/sections match the connection design in the calculation report?	☐	☐	☐	☐	☐	☐
20	Does lateral force -resisting bracing system shown on the structural steel framing plans/sections match the system assumed in the calculation?	☐	☐	☐	☐	☐	☐
21	Does slenderness ratio of steel columns comply with code?	☐	☐	☐	☐	☐	☐
22	Is bay spacing adequate for architectural cladding?	☐	☐	☐	☐	☐	☐
23	Has expansion joint location been identified on the drawing?	☐	☐	☐	☐	☐	☐
Co-related Documents							
24	Has reference been provided for General Notes drawing?	☐	☐	☐	☐	☐	☐
25	Does drawing include reference of interface drawings (MEP, Civil and architectural drawings)?	☐	☐	☐	☐	☐	☐
26	Have the referenced drawings, applicable to framing plans been provided?	☐	☐	☐	☐	☐	☐

Attachment 5 - EPM-KES-TP-000005 - Checklist - Retaining Wall Drawing (Structural) – Template

PROJECT NAME:	DRAWING NO.	REV.

No.	QUESTIONS	ORIGINATOR			CHECKER		
		N/A	YES	NO	N/A	YES	NO
Preparation and Checking							
01	Does the drawing comply with applicable codes, standards and regulatory requirements?	☐	☐	☐	☐	☐	☐
02	Does the drawing comply with applicable project design criteria, system or structural functional requirements, Scope Book, and Design basis documents?	☐	☐	☐	☐	☐	☐
03	Do the Allowable Bearing Capacity (ABC) and settlement on the drawing comply with geotechnical report?	☐	☐	☐	☐	☐	☐
04	Does the concrete cover to reinforcement comply with Project specifications?	☐	☐	☐	☐	☐	☐
05	Does the compressive strength of concrete comply with project Specifications?	☐	☐	☐	☐	☐	☐
06	Does the grades of Reinforcement steel comply with project Specifications?	☐	☐	☐	☐	☐	☐
07	Does the splice length of tension splice comply with codes?	☐	☐	☐	☐	☐	☐
08	Does the development/anchorage length of rebar comply with code?	☐	☐	☐	☐	☐	☐
09	Does the backfill around the structure comply with Project specifications?	☐	☐	☐	☐	☐	☐
10	Do the wall configurations match the calculations submitted for each proposed wall, which demonstrate the walls structural adequacy to resist the applicable design loads within the specified allowable soil bearing pressure, and to maintain a minimum Factor of Safety against bearing, overturning and sliding, sliding and bearing for reinforced concrete walls?	☐	☐	☐	☐	☐	☐
11	Is the shear key required for stability?	☐	☐	☐	☐	☐	☐
12	Does the eccentricity of wall comply with code?	☐	☐	☐	☐	☐	☐
13	Has the coefficient of friction between foundation & soil been reduced to account for the membrane under the foundation?	☐	☐	☐	☐	☐	☐
14	Have the effect of the ground water table and design flood levels been considered in the calculation report?	☐	☐	☐	☐	☐	☐
15	Have the erosion and scour protections been considered in the design?	☐	☐	☐	☐	☐	☐
16	Have water stops been provided at expansion & construction joints in the retaining walls?	☐	☐	☐	☐	☐	☐
17	Are special drainage features behind the wall shown as required?	☐	☐	☐	☐	☐	☐
18	Have dowels at expansion joint been provided for load transfer?	☐	☐	☐	☐	☐	☐
19	Has the lining on the inner face which will be exposed to chemicals been provided?	☐	☐	☐	☐	☐	☐
20	Has the retaining wall with a barrier on top, been checked for vehicle collision load?	☐	☐	☐	☐	☐	☐
21	Have weep holes been provided for drainage?	☐	☐	☐	☐	☐	☐
22	Has the clash with underground utilities/manholes been checked?	☐	☐	☐	☐	☐	☐
23	Will the backfill soil have the same properties (angle of internal friction, unit weight, submerged weight etc.) as used in the design?	☐	☐	☐	☐	☐	☐
Co-related Documents							
24	Has reference to the General Notes drawing been provided?	☐	☐	☐	☐	☐	☐
25	Have references to interface drawings (MEP & Architecture) been provided?	☐	☐	☐	☐	☐	☐
26	Has reference to a list of drawing been provided?	☐	☐	☐	☐	☐	☐
Coordination and Review							

Attachment 6 - EPM-KES-TP-000006 - Checklist - Precast Elements Drawing – Template

PROJECT NAME:	DRAWING NO.	REV.

No.	QUESTIONS	ORIGINATOR			CHECKER		
		N/A	YES	NO	N/A	YES	NO
Preparation and Checking							
	(This Check List Does not cover Pre-Tension or Post Tension Elements)						
01	Does the drawing comply with applicable codes, standards and regulatory requirements?	☐	☐	☐	☐	☐	☐
02	Does the drawing comply with applicable project design criteria, system or structural functional requirements, Scope Book, and Design basis documents considered?	☐	☐	☐	☐	☐	☐
03	Are the precast elements and its details as shown on the drawing, supported and validated by structural calculations?	☐	☐	☐	☐	☐	☐
04	Does specified compressive strength (28-day) of precast elements comply project specifications?	☐	☐	☐	☐	☐	☐
05	Does specified compressive strength (28-day) of in-situ concrete comply project specifications?	☐	☐	☐	☐	☐	☐
06	Do type and grade of rebar comply with project specifications?	☐	☐	☐	☐	☐	☐
07	Does material grade for lifting lug/hook comply with project specifications?						
08	Have the precast elements been checked for lifting stage?	☐	☐	☐	☐	☐	☐
09	Have precast elements been checked in calculations for concrete strength at the time of lifting?	☐	☐	☐	☐	☐	☐
10	Does shear reinforcement as shown in calculation in precast elements adequate for composite action?	☐	☐	☐	☐	☐	☐
11	Has the top surface of precast elements been roughened for in-situ concrete bonding (in composite construction), as assumed in the calculation?	☐	☐	☐	☐	☐	☐
12	Does bearing for precast elements as shown on drawing supported by calculation and comply with code requirements?	☐	☐	☐	☐	☐	☐
13	Has the precast element designed for wet weight of concrete (or construction stage) in the calculation report?	☐	☐	☐	☐	☐	☐
14	Does the design of precast element check for construction live load?	☐	☐	☐	☐	☐	☐
15	Does the design of lifting lug/hook include dynamic allowance?	☐	☐	☐	☐	☐	☐
16	Is embedded depth of lifting lug as shown on drawing adequate for lifting supported by calculation report?	☐	☐	☐	☐	☐	☐
17	Has lifting hook been checked for concrete pull out strength in the calculation report?	☐	☐	☐	☐	☐	☐
18	Has the splice length at connection between precast and in-situ concrete been check in calculation and it complied with code?	☐	☐	☐	☐	☐	☐
19	Have the openings in precast elements been considered in the calculations for permanent and lifting stages?	☐	☐	☐	☐	☐	☐
Co-related Documents							
20	Has reference been provided for General Notes drawing?	☐	☐	☐	☐	☐	☐
21	Does drawing include reference of interface drawings (MEPF & Architecture)?	☐	☐	☐	☐	☐	☐
22	Has reference been provided for the list of drawings?	☐	☐	☐	☐	☐	☐
Coordination and Review							
23	Has appropriate interdisciplinary and intradepartmental coordination been done?	☐	☐	☐	☐	☐	☐
24	Have reviewers from other disciplines/departments evaluated items pertinent to their area and provided their comments?	☐	☐	☐	☐	☐	☐

Attachment 7 - EPM-KES-TP-000007 - Checklist Structural Steel Connections Drawing – Template

PROJECT NAME:	DRAWING NO.	REV.

No.	QUESTIONS	ORIGINATOR			CHECKER		
		N/A	YES	NO	N/A	YES	NO
Preparation and Checking							
01	Does the drawing comply with applicable codes, standards and regulatory requirements?	☐	☐	☐	☐	☐	☐
02	Does the drawing comply with applicable project design criteria, system or structural functional requirements, Scope Book, and Design basis documents considered?	☐	☐	☐	☐	☐	☐
03	Do the connections validate the design calculations reports?	☐	☐	☐	☐	☐	☐
04	Do the grades of structural connection bolt comply with project Specifications?	☐	☐	☐	☐	☐	☐
05	Are the type, diameters and coating i.e. galvanized, of structural bolts shown on the drawing?	☐	☐	☐	☐	☐	☐
06	Does the grade of nuts comply with project specifications?	☐	☐	☐	☐	☐	☐
07	Does the grade of connection plates (stiffener plates) comply with project Specifications?	☐	☐	☐	☐	☐	☐
08	Does the hole size of bolt in connection plates comply with code and with the assumptions made in the calculation?	☐	☐	☐	☐	☐	☐
09	Does the edge distance of bolt in connection plate (or in flange or web of rolled section) comply with code?	☐	☐	☐	☐	☐	☐
10	Does the center to center distance between bolts comply with code?	☐	☐	☐	☐	☐	☐
11	Have all types of connections been indicated on the drawing?	☐	☐	☐	☐	☐	☐
12	Is type of connection i.e. snug tight, fully pre-tensioned or slip critical clearly shown on the drawing?	☐	☐	☐	☐	☐	☐
13	Has the clash between steel column and nut or washer been checked?	☐	☐	☐	☐	☐	☐
14	Have two dissimilar metals been isolated to avoid corrosion due to galvanic action?	☐	☐	☐	☐	☐	☐
15	Has correct coefficient of friction been used for friction grip (slip critical) bolts?	☐	☐	☐	☐	☐	☐
16	Does type of steel connections (shear or moment) match with design report?	☐	☐	☐	☐	☐	☐
17	Does grade of electrodes comply with code?	☐	☐	☐	☐	☐	☐
18	Has compatibility of electrodes with respect grade of steel been checked?	☐	☐	☐	☐	☐	☐
19	Has compatibility of weld thickness with Plate thickness been checked?	☐	☐	☐	☐	☐	☐
20	Does drawing include all relevant welding symbols?	☐	☐	☐	☐	☐	☐
21	Has a note for minimum weld size provided in the drawing?	☐	☐	☐	☐	☐	☐
Co-related Documents							
22	Has reference been provided for the list of drawing?	☐	☐	☐	☐	☐	☐
23	Has reference been provided for the General Notes drawing?	☐	☐	☐	☐	☐	☐
24	Has reference been provided for the Framing Plan showing connection types (shear or moment, etc.)?	☐	☐	☐	☐	☐	☐
Coordination and Review							
25	Has appropriate interdisciplinary and intradepartmental coordination been done?	☐	☐	☐	☐	☐	☐
26	Have reviewers from other disciplines/departments evaluated items pertinent to their area and provided their comments?	☐	☐	☐	☐	☐	☐
27	Has the Responsible engineer resolved their comments?	☐	☐	☐	☐	☐	☐
28	If applicable has the drawing been stamped by a registered professional engineer?	☐	☐	☐	☐	☐	☐
29	Has the drawing been checked for constructability?						

Attachment 8 - EPM-KES-TP-000008 - Checklist - General Notes Drawing – Template

PROJECT NAME:	DRAWING NO.	REV.

No.	QUESTIONS	ORIGINATOR			CHECKER		
		N/A	YES	NO	N/A	YES	NO
Preparation and Checking							
01	Does the drawing comply with applicable codes, standards and regulatory requirements?	☐	☐	☐	☐	☐	☐
02	Does the drawing comply with applicable project design criteria, system or structural functional requirements, Scope Book, and Design basis documents considered?	☐	☐	☐	☐	☐	☐
03	Is the coordinate system and site arrow direction (Mecca) on drawing correct?	☐	☐	☐	☐	☐	☐
04	Do the Allowable Bearing Capacity (ABC) and the settlements on the drawing comply with geotechnical report?	☐	☐	☐	☐	☐	☐
05	Does the Specified grade of structural steel comply with project Specifications?	☐	☐	☐	☐	☐	☐
06	Does the Specified grade of hollow steel sections comply with project Specifications?	☐	☐	☐	☐	☐	☐
07	Does the Specified grade of cold form steel comply with project Specifications?	☐	☐	☐	☐	☐	☐
08	Does the Specified grade of stainless steel comply with project Specifications?	☐	☐	☐	☐	☐	☐
09	Does the Specified grade of welding electrode comply with code?	☐	☐	☐	☐	☐	☐
10	Does drawing include a note for minimum fillet weld?	☐	☐	☐	☐	☐	☐
11	Does type of concrete/concrete mix comply with project Specifications?	☐	☐	☐	☐	☐	☐
12	Does the specified compressive strength (28-days) of RCC concrete (Sub-structure and super-structure) comply with project Specifications?	☐	☐	☐	☐	☐	☐
13	Does the specified compressive strength (28-days) of mass concrete comply with project Specifications?	☐	☐	☐	☐	☐	☐
14	Does the drawing specify the specified compressive strength (28-days) of precast (not pre/post tensioned) concrete members and also this comply with project specifications?	☐	☐	☐	☐	☐	☐
15	Does drawing specify the minimum specified compressive strength of precast concrete elements at lifting stage?	☐	☐	☐	☐	☐	☐
16	Does drawing specify the specified compressive strength (28-days) of non-shrink grout and this comply with project specifications?	☐	☐	☐	☐	☐	☐
17	Does drawing specify the specified compressive strength (28-days) of cement/sand mortar, type of mortar and also this comply with project specifications?	☐	☐	☐	☐	☐	☐
18	Does drawing specify the specified compressive strength (28-days) of blinding concrete and this comply with project specifications?	☐	☐	☐	☐	☐	☐
19	Does the type and grade of anchor bolts comply with project Specifications?	☐	☐	☐	☐	☐	☐
20	Does the type and grade of structural fasteners comply with project Specifications?	☐	☐	☐	☐	☐	☐
21	Does the drawing include a note for the separation of two dissimilar metals to avoid corrosion?	☐	☐	☐	☐	☐	☐
22	Does the grade of reinforcement steel comply with project Specifications?	☐	☐	☐	☐	☐	☐
23	Have the splice lengths for tension and compression rebars been checked with Codes?	☐	☐	☐	☐	☐	☐
24	Does drawing include table for splice lengths?	☐	☐	☐	☐	☐	☐
25	Does the drawing specify the limit on construction loads? Construction load shall not exceed live load considered in the design.	☐	☐	☐	☐	☐	☐
26	Does concrete cover comply with Project specifications?	☐	☐	☐	☐	☐	☐

Attachment 9 - EPM-KES-TP-000009 - Template - Structural Design Criteria – Template

EXPRO

Template - Structural Design Criteria

Table of Contents

EXPRO

Template - Structural Design Criteria

1.0 GENERAL

This section describes basic format of structural design criteria template which should be included in all types of structural design basis.

1.1 Scope

The design criteria template covers the following:

- Site location
- Applicable codes, standards and regulations
- Environmental data
- Geotechnical data
- Specifications
- Loads and load combinations
- Serviceability limits
- Strength and stability limits

1.2 Codes, Standards and Regulations

List the applicable:

- National codes,
- International codes/standards, including the code
- Regulations, and
- Guideline specifications

[Any deviation from the codes and regulations to be permitted after obtaining written approval of the national authorities/Entity.]

1.3 Hierarchy of Specifications

[State hierarchy for the project specifications. Hierarchy will be used where a conflict or difference occurs between specification sources.]

1.4 Design Life

Describe design service life of:

- Concrete buildings/structures
- Structural Steel buildings/structures
- Bridges/underpasses/Road culverts
- Concrete platforms
- Steel platforms/walkways
- Earth and water retaining structures
- Structural Steel/GRP gratings etc.

[State the design service life of each structure which is in the scope of work. The design service life denotes the duration that the facility will continue to be in service. Inspection and maintenance program shall be defined. Mention that structures and elements of structures shall be designed in such a way to ensure a safe and structurally sound behavior during the prescribed design service life under the expected loads in accordance to the national and international codes and standards]

1.5 Units, Elevations and Datum

Describe:

- Unit system
- Dimensions

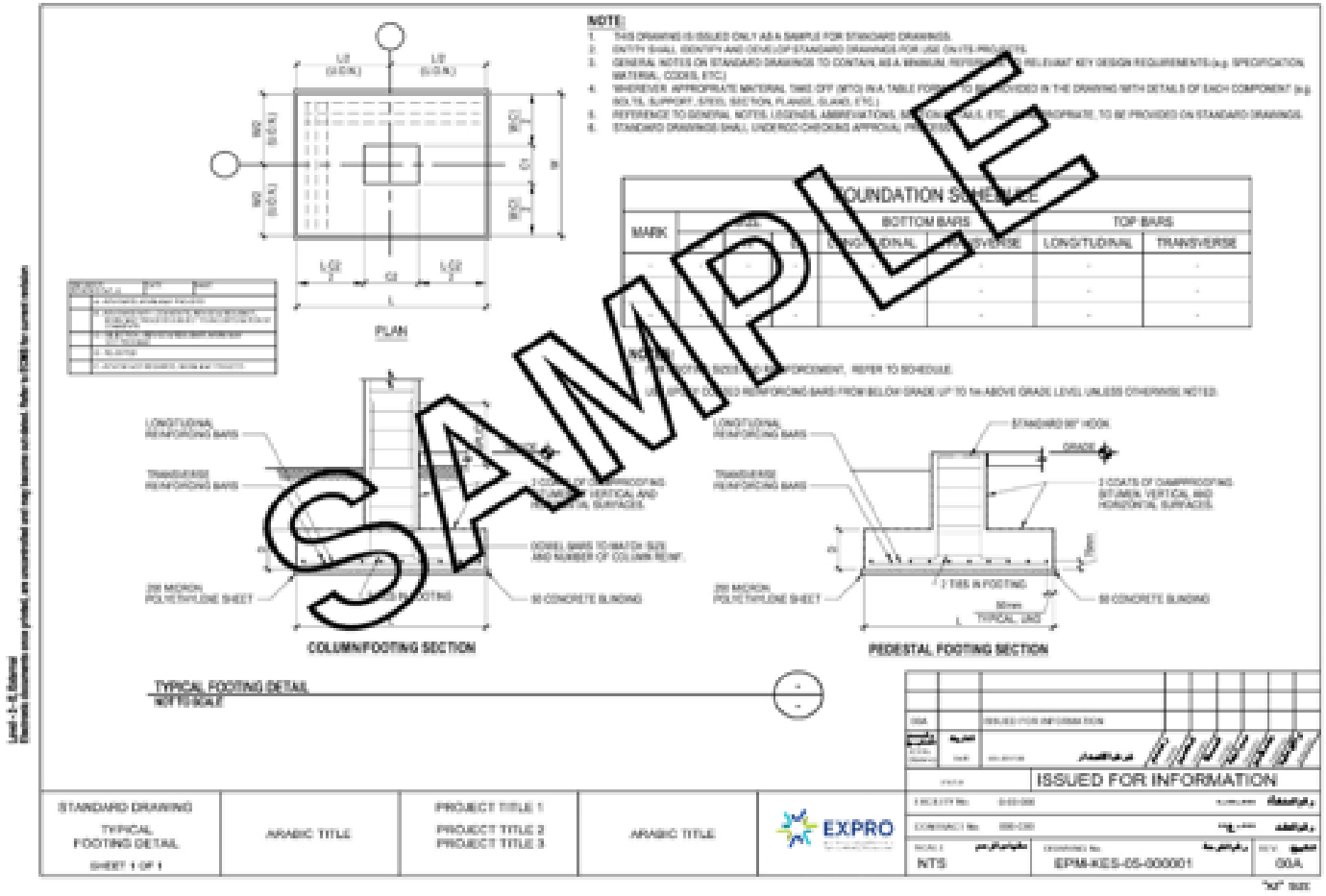
Attachment 10 - EPM-KES-RG-000001 - List of Structural Deliverables - Template

EXPRO

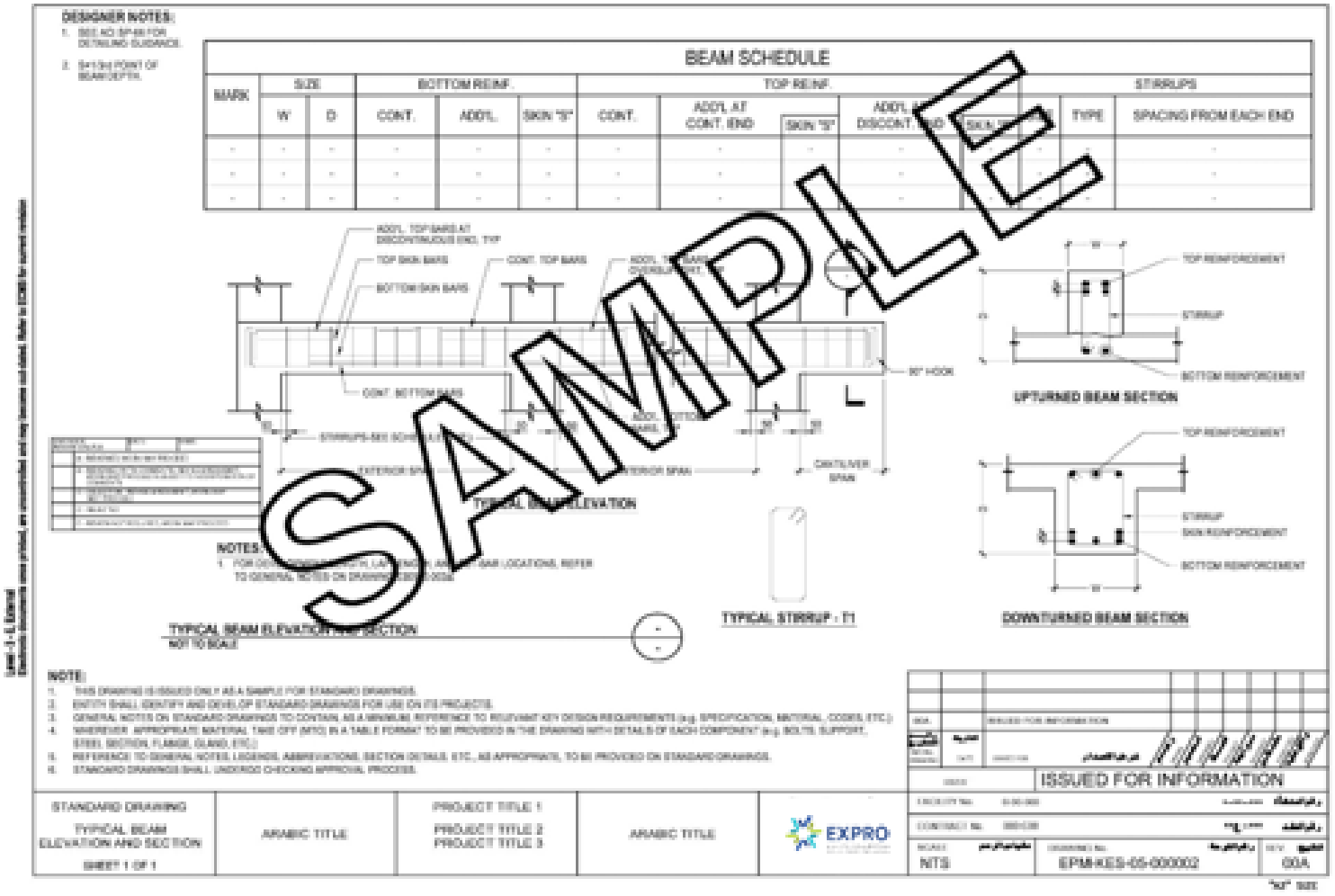
LIST OF STRUCTURAL DELIVERABLES

SN	Deliverable	Tool	Deliverable Contents	Developed During *	Deliverable/ Data required for				Comments
					Procurement	Construction	Start-up & Commissioning	Project Controls	
1	3D Model	See comment	The 3D model shall show realistic depictions and contain relevant design data for all physical disciplines in sufficient detail as per the project 3D CAD procedures	B&D	Y	Y	Y		Refer to Project Design Criteria for the requirement of 3D modelling and software to be used (typical comment, applicable for all disciplines)
2	Construction Facilities / Site Coordinating Plan	2D	Shows the location and type of required facilities, including lay down areas, trailer locations, fabrication areas, and temporary warehouses.	B		Y			Project to determine if this is done by Engineering or Construction, applicable for all disciplines
3	Permitting submittals	PDF	Includes documents and drawings required for applicable construction and environmental permitting activities for the project	B		Y			Refer to project permiting requirements, applicable for all disciplines
4	Load Assessment Studies	MS Word/PDF	Includes applied load studies like wind, seismic, rainfall, etc.	B					
5	Design Basis / Design Criteria Document	MS Word	Refer document EPM-KES-TP-000005 and EPM-KER-TP-000030 for the [illegible] Design Criteria	B		Y			Each discipline will develop its Design Criteria
6	Scope of Work/ Specifications	MS Word	Refer to templates EPM-KES-GDL-000006 and EPM-KEO-TP-000009 for the contents of SOW and Specifications	B&D	Y	Y	Y		
7	Vendor drawings	2D/PDF	Includes overhead gantry crane details, reactions, Plan & section, construction tolerances, equipment Foundation details and reactions.	D	Y	Y			gantry crane drawings, equipment reaction drawings
8	Bulk Quantity Takeoff / BOQ	2D	Bulk Quantity Takeoffs (QTOs) for tracking engineering-released quantities at 30%, 60%, & 90% Milestones to support construction.	B&D		Y		Y	Similar requirements for other disciplines (Structural, Mechanical, Civil, etc.)
9	Boring Location Plan	2D	Used by the Geotech engineering group to locate site soil exploration borings needed to establish foundation conditions. Note: If Geotech services are subcontracted, specify deliverable requirements placed on the subcontractor.	B		Y			
10	General Arrangement Plans & Sections	2D	Shows general arrangement of building and structures and its interface with other structures, utilities and future developments	B&D		Y			

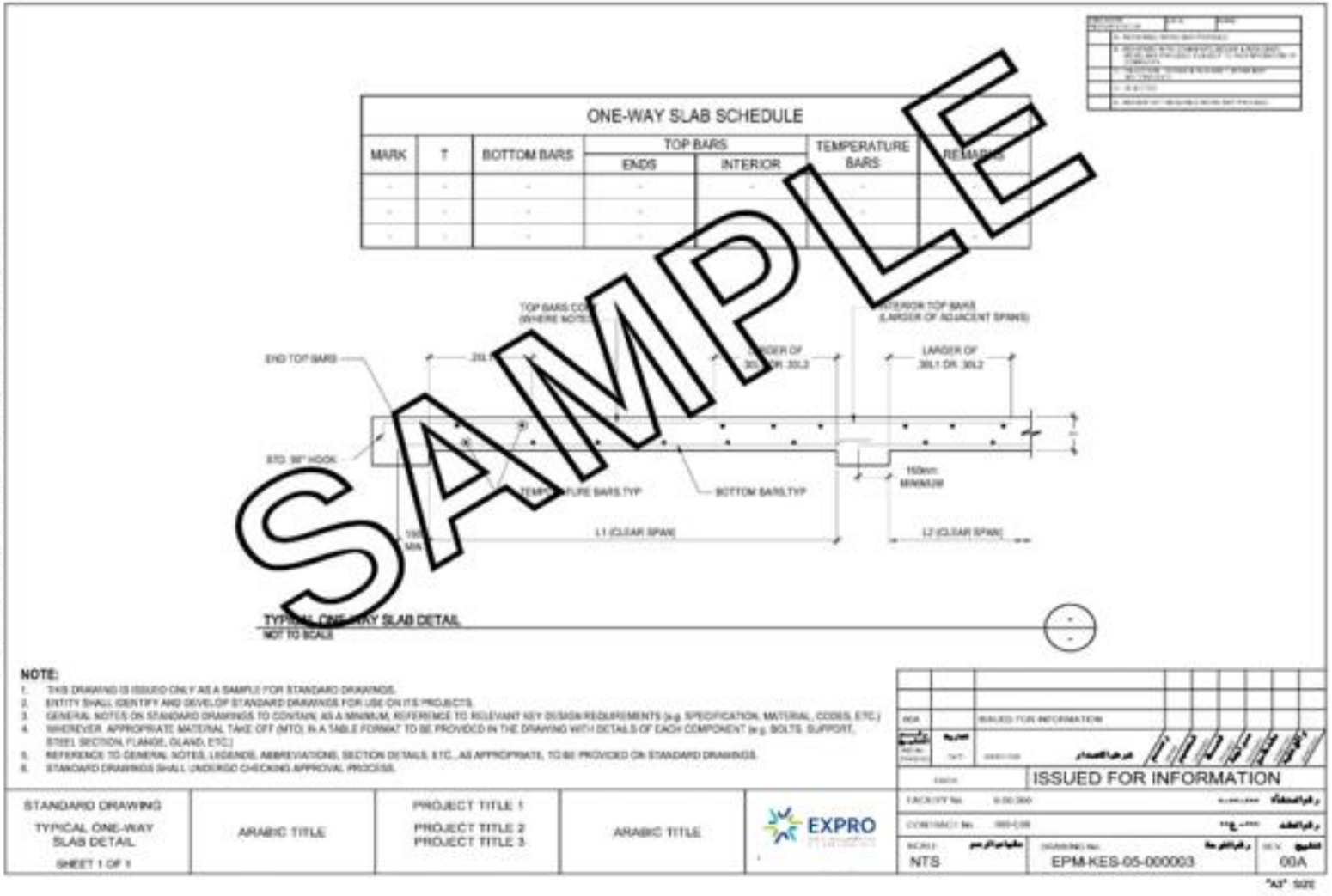
Attachment 11 - EPM-KES-05-000001 - Drawing - Typical Footing Detail - Template



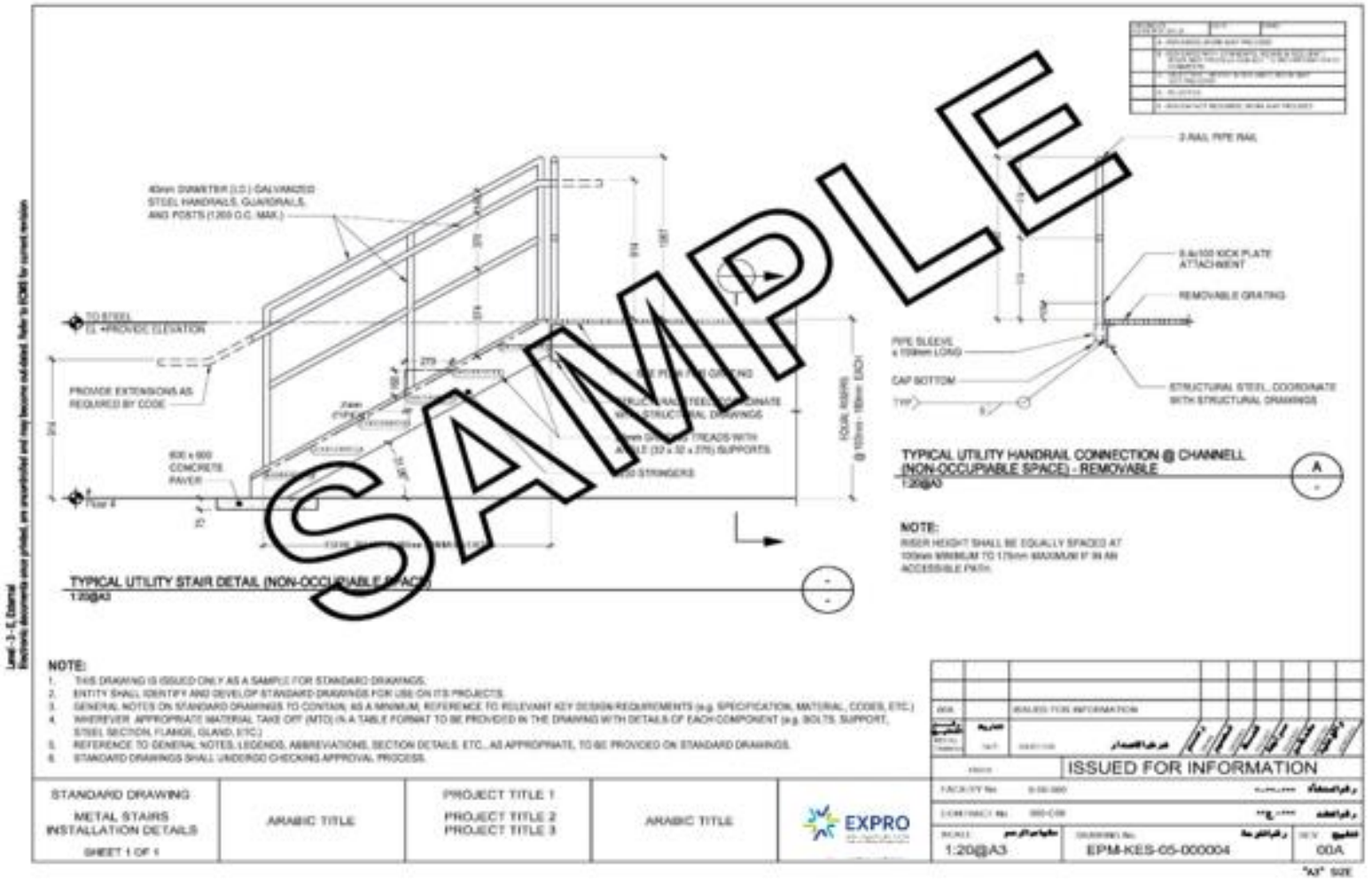
Attachment 12 - EPM-KES-05-000002 - Drawing - Typical Beam Elevation and Section - Template



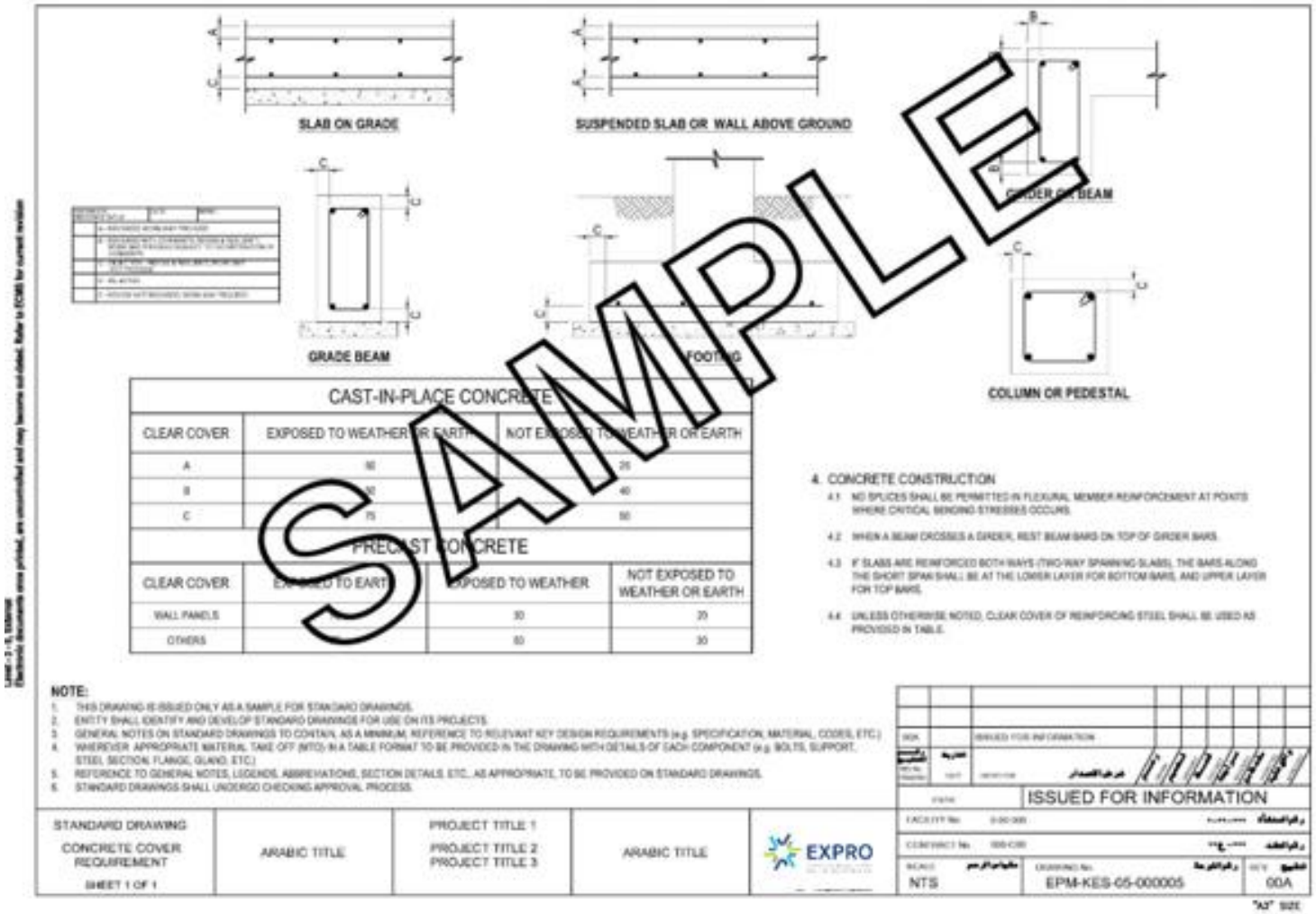
Attachment 13 - EPM-KES-05-000003 - Drawing - Typical One-Way Slab Detail - Template



Attachment 14 - EPM-KES-05-000004 - Drawing - Metal Stairs - Template



Attachment 15 - EPM-KES-05-000005 - Drawing -Concrete Cover Requirement - Template



Attachment 16 - EPM-KES-TP-000011 - Checklist - Transportation Structural GA Drawing - Template

PROJECT NAME:		DRAWING NO.			REV.		
No.	**QUESTIONS**	**ORIGINATOR**			**CHECKER**		
		N/A	**YES**	**NO**	**N/A**	**YES**	**NO**
Preparation and Checking							
01	Does the drawing comply with applicable codes, standards and regulatory requirements?	☐	☐	☐	☐	☐	☐
02	Does the drawing comply with applicable project design criteria, system or structural functional requirements, Scope Book, and Design basis documents considered?	☐	☐	☐	☐	☐	☐
03	Are applicable specifications/ standard details referenced in the note sections?	☐	☐	☐	☐	☐	☐
04	Has material information been mentioned on drawing related to concrete, reinforcing steel, pre-stressing material etc.?	☐	☐	☐	☐	☐	☐
05	Does the concrete coating/protection system comply with Project Specifications?	☐	☐	☐	☐	☐	☐
06	Does the drawing identifies precast and cast-in-place concrete portions clearly?	☐	☐	☐	☐	☐	☐
07	Are the coordinate system and the clear zone dimensions shown on drawing correct?	☐	☐	☐	☐	☐	☐
08	Does the drawing clearly provides the road layout with dimensions to carriage way, shoulders, swale, median, directional arrow etc.	☐	☐	☐	☐	☐	☐
09	Are control-lines, Control-Work-Points and profiles (vertical/ horizontal) shown clearly on the drawing?	☐	☐	☐	☐	☐	☐
10	Does the drawing show required clear distances to the passageway running under or over?	☐	☐	☐	☐	☐	☐
11	Are the gaps, at expansion joints, adequate to accommodate movement of deck without any interference?	☐	☐	☐	☐	☐	☐
12	Has the drawing identified type of bearings, size, numbers, locations and their installation details?	☐	☐	☐	☐	☐	☐
13	Does the drawing clearly mention "Pre-stressed", "Pre-tensioned" and "Post-tensioned" components and their details?	☐	☐	☐	☐	☐	☐
14	Are drain troughs, trough-terminals locations and details shown on drawing?	☐	☐	☐	☐	☐	☐
15	At abutment & wing walls - have the fill profile, Material and protection been mentioned on the drawing?	☐	☐	☐	☐	☐	☐
16	Is there any design/ detailing scope left for construction?"	☐	☐	☐	☐	☐	☐
17	Is the Constructability review done and recommendations considered for design?	☐	☐	☐	☐	☐	☐
Co-related Documents							
18	Has the reference for General Notes drawing been provided?	☐	☐	☐	☐	☐	☐
19	Have the references of interface drawings (MEPF & Architecture) been provided?	☐	☐	☐	☐	☐	☐
20	Has reference of list of drawings been provided?	☐	☐	☐	☐	☐	☐
Coordination and Review							