DURA® PMB – Pedestrian-Motorcycle Bridge for IBS

Description

DURA® PMB-IBS is a total prefabricated system which is ideal for the concept of industrial building system (IBS) for pedestrian-motorcycle bridge construction. **DURA® PMB-IBS** is manufactured using the advanced composite material of ultra-high performance concrete and high-carbon-high-tensile steel fibers (UHPdC). It is an excellent solution for bridge engineers looking for a cost effective, fast construction, light-weight and high-durability option for girders with a span range of 23 to 41 meters. Unlike conventional design, DURA® PMB-IBS is a 100% precast system which included the bridge, ramps, staircase, columns, crossheads and landing slabs.

Features

- All the major component in **DURA® PMB-IBS** are manufactured using DURA® UHPdC material, except the foundations (i.e. piling and pile caps) are constructed using conventional method.
- The UHPdC used for **DURA® PMB-IBS** has characteristic compressive strength range between 120 to 140 MPa.
- The UHPdC used for **DURA® PMB-IBS** contained high amount of high strength micro-steel fiber which results a minimum characteristic flexural strength of 20 MPa.
- DURA® prestress girders are typically prestress to 70~80% of the characteristic tensile strength of the strands. Strands used are 15.2 mm diameter 7-wire super strands (low relaxation) complying with BS 5896-1980; with a characteristic breaking load of 260 kN.
- All steel fibers used are made from high carbon steel wires with tensile strength more than 2300 MPa.
- **DURA® PMB-IBS** components eliminate the used of conventional steel reinforcing bars and stirrups, except at the region where connection is required with in-situ cast concrete to form a connectivity.

Advantages of DURA® PMB – IBS

- Based on a 41 m span design, the **DURA® PMB-IBS** can be more than 50% lighter when compared to conventional designs. For example, using two pieces of conventional I-girders with an in-situ RC deck will result a total dead weight of 3780 kg/m. Whereas the DURA® prestress girder only weights 1400 kg/m, thus resulting in a 60% reduction of dead weight;
- At least 3 times more durable as DURA® consist lots of discrete high strength steel fibers to stitch cracks (if any) and the girders are designed based on uncracked approach at serviceability limit state, (thus significantly increasing the life span of the infrastructure);
- Ease of handling (due to light weight) and fast in construction (due to total prefabricated system);
- Savings in foundation cost can be attained due to the lighter superstructure (especially on difficult ground condition);
- Height reduction leads to reduces staircase and ramp travelling distance as well as direct cost saving;
- Eliminates site-casting of R.C. deck, thus enabling overall construction safety and minimizing site activity;
- Due to the absence of conventional steel reinforcements, DURA® girders can be designed and produced in a much slenderer and efficient sections, with no concern for classical issues such as minimum concrete cover, to prevent corrosion of steel reinforcement;
- No waterproofing needed as DURA® is a highly impermeable material;
- No wearing surface material needed on the deck surface as anti-slip and anti-skid profiles can been provided on the deck surface thus eliminating the need for maintenance and repair due to debonding or wearing of the overlay;
- Its natural high quality finish due to the ultra-packed nature of the concrete matrix eliminates the need for painting or protective coating (thus leading to further long term savings in cost). Micro-organism such as mould and algae will also not grow easily on this surface;
- Longer single spans up to 50 meter is possible, eliminating the central column which improved public safety;
- A high green-index material which supports the visionary of sustainable construction by reducing the overall CO_2 emission, primary energy consumption and global warming potential of at least 15%.
- It is a cost effective solution offering cost savings, both immediate and long term.

STANDARD FEATURES

The total prefabricated system of DURA® PMB-IBS comes with the following standard precast components:

(1) **DURA® PMB41**: 1 set of ultra-light, long span precast post-tensioned bridge (L_{max} = 41m) comes with precast railings;

(2) **DURA® PMR23**: 6 sets of standard precast pre-tensioned ramp girders (L=23 m) come with precast railings;

(3) **DURA® CH1**: 2 sets of crosshead for the sitting of DURA® PMB41, DURA® PMR23, and precast staircase DURA® ST300/200;

(4) **DURA® CH2**: 2 sets of crosshead (i.e. turning slab) for the sitting of DURA® PMR23;

(5) **DURA® CH3**: 2 sets of crosshead (i.e. intermediate landing slab for staircase) for the sitting of DURA® ST300/200;

(6) **DURA® CH4**: 2 sets of intermediate crosshead for the sitting of DURA® PMR23;

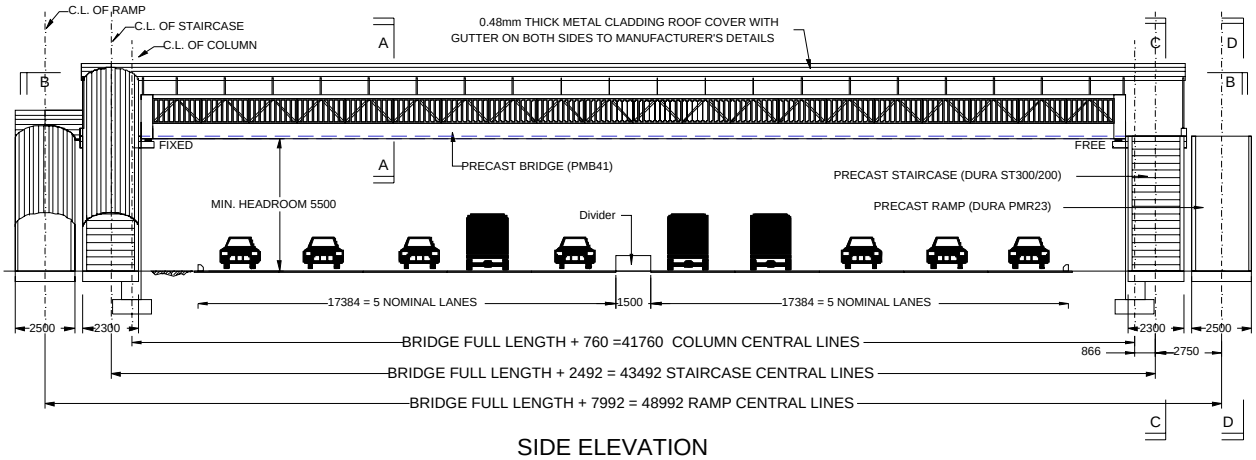
(7) **DURA® C1**: 2 sets of precast column (H = 6.35m) for crosshead DURA® CH1;

(8) **DURA® C2**: 4 sets of precast column (H = 4.75m) for crosshead DURA® CH2;

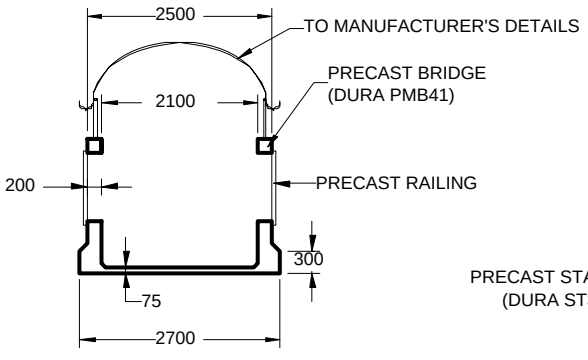
(9) **DURA® C2**: 2 sets of precast column (H = 3.65m) for crosshead DURA® CH3;

(10) **DURA® C2**: 2 sets of precast column (H = 2.7m) for crosshead DURA® CH4; and

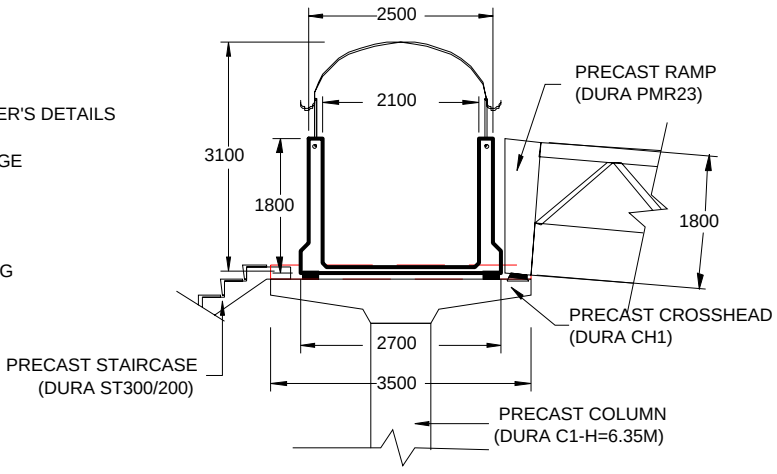
(11) **DURA® ST300/200**: 4 sets of ultra-light weight precast staircase.



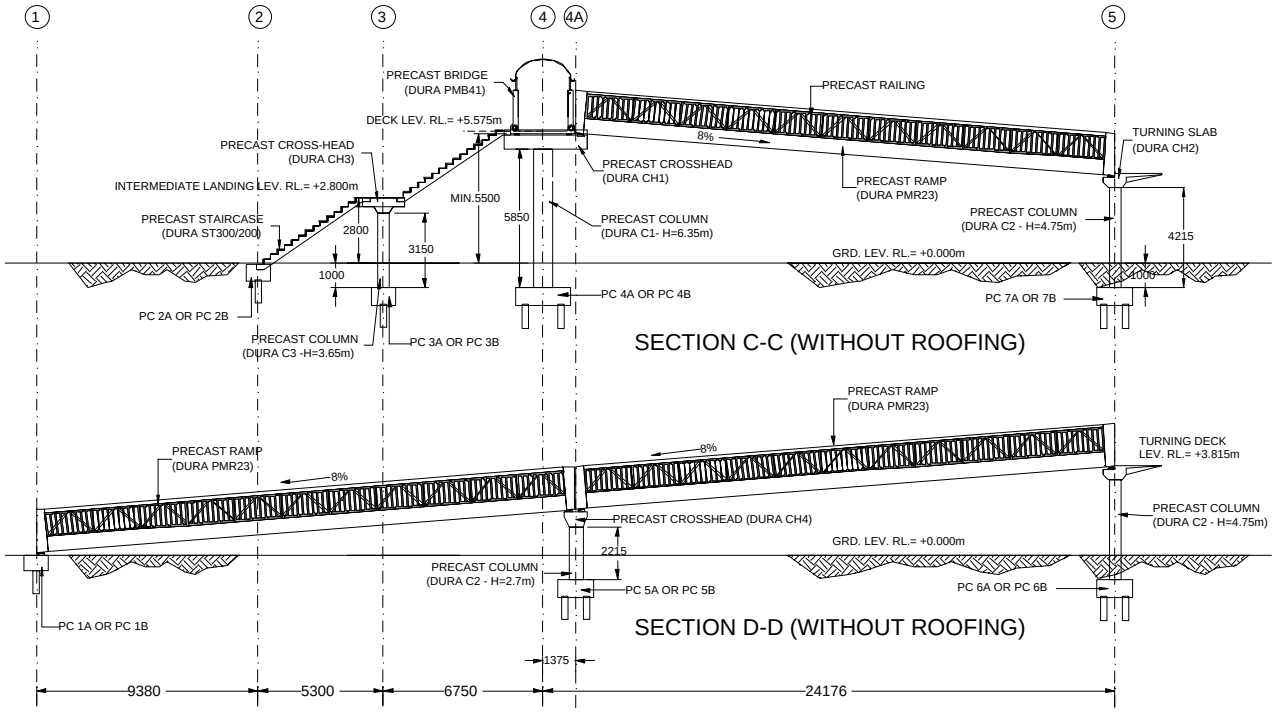
SIDE ELEVATION

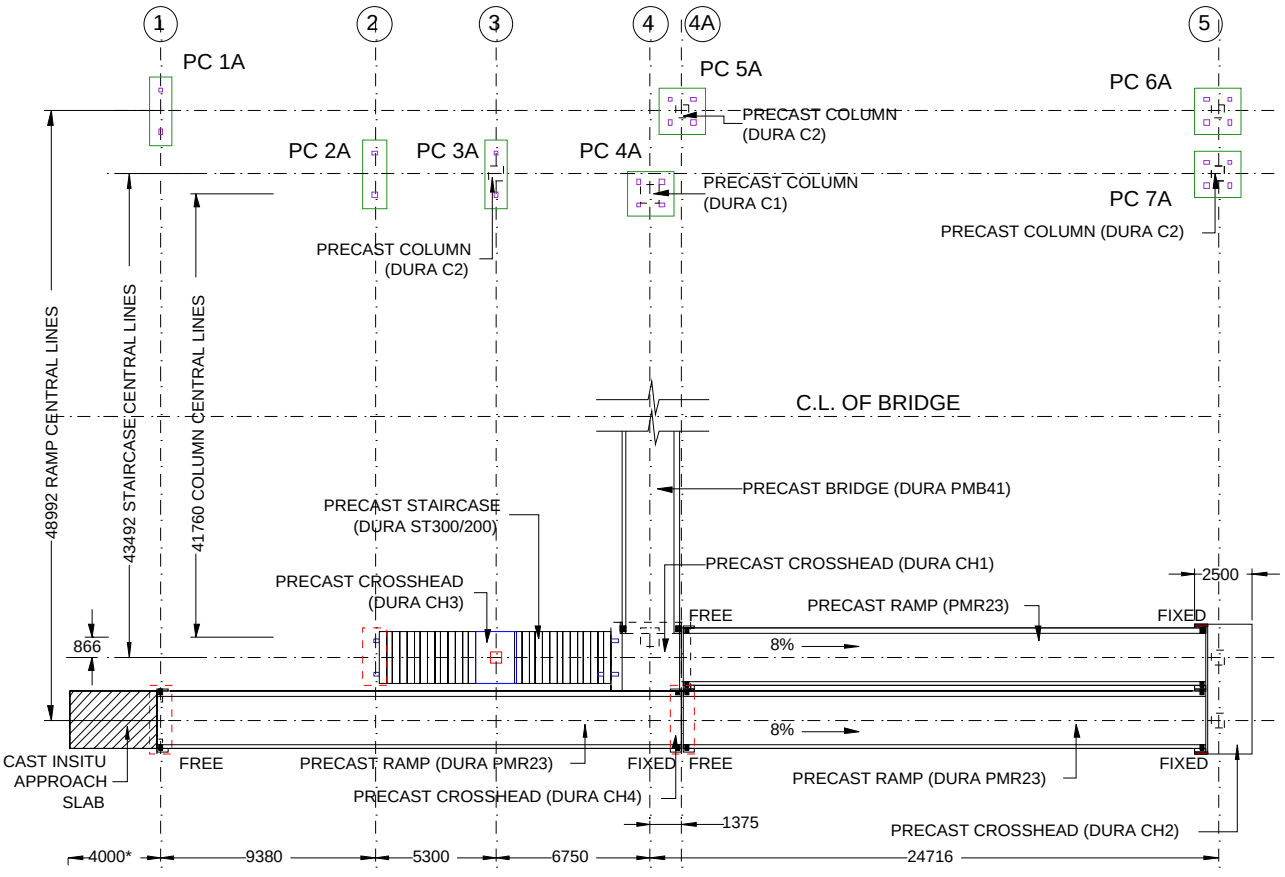


SECTION A-A

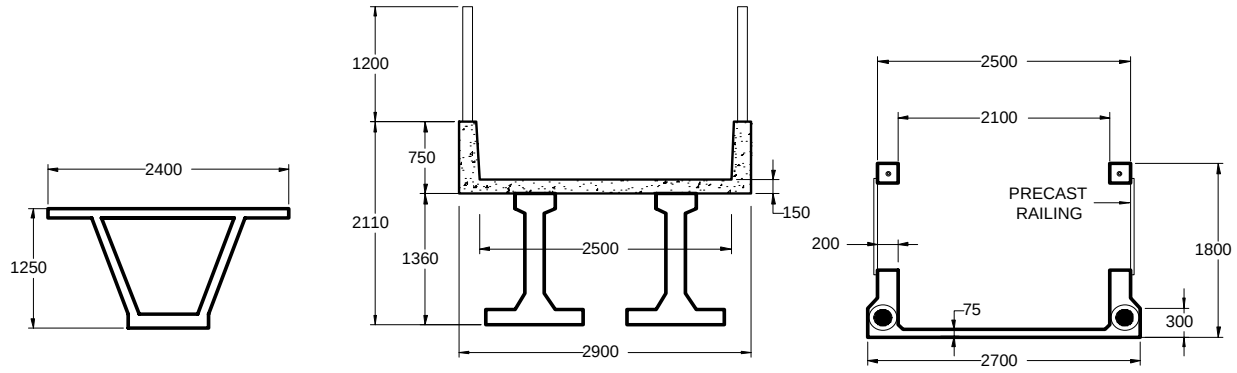


SECTION C-C





SECTIONAL PLAN (B-B) (ROOF & RAILING NOT SHOWN)



Box Beam (1500 kg/m)
Up to 29 meters

M10 I-Beams (3780 kg/m)
Up to 35 meters

DURA Girder (1400kg/m)
Up to 41 meters

Comparison of DURA® Girder to conventional systems.

Table 1: Technical Data for DURA® PMB-IBS Standard Girders.

		Unit	DURA® PMB	DURA® PMR
Purpose			**Bridge Crossing**	**Ramp**
Prestressing Method			**POST-Tension**	**PRE-Tension**
Length ↑	**L**	**m**	**25 ~ 41**	**23**
Self-Weight	**W**	**kN/m**	**14**	**14**
Sectional Area ↑↑	A_g	**x 10^3 mm^2**	**533.4**	**533.4**
Neutral Axis ↑↑	y_{top}	**mm**	**1326**	**1326**
	y_{bot}	**mm**	**474**	**474**
Moment of Inertia ↑↑	I_{xx}	**x 10^9 mm^4**	**182**	**182**
Section Modulus ↑↑	Z_{top}	**x 10^6 mm^3**	**137.3**	**137.3**
	Z_{bot}	**x 10^6 mm^3**	**384.3**	**384.3**
Total Depth	**D**	**mm**	**1800**	**1800**
1st Natural Frequency *	**Horizontal**	**Hz**	**860 $L^{-1.5543}$**	**6.60**
	Vertical	**Hz**	**3530 $L^{-1.98}$**	**7.03**

↑ Incremental length of 2m; ↑↑ Excluded diagonal truss; * Regression best fit with R^2 = 1.0 and L = span length

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