

IPWESeminar – JAN 2016

FAST TRACK CONSTRUCTION OF ROB/RUB

An article by

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Synopsis:

In this paper, few methods and suggestions for expediting construction of railway span of ROB (Track span) are being discussed.

'U' type of girder for ROBs across new lines/GC work and tunnel like RC box inside deep cuttings are advocated as sound / optional technical solutions.

Segmental construction and ideal location of LUS are also suggested for speedy execution and avoiding obstacles at site.

Novel method adopted in Southern Railway for construction of RUBs as a long single joint free barrel by a combination method of "*cut open & push the single long barrel*" in order to effect economy, efficiency & speed of construction is also discussed.

(A) FOR FAST PACE CONSTRUCTION OF ROB

I. Across the existing track:

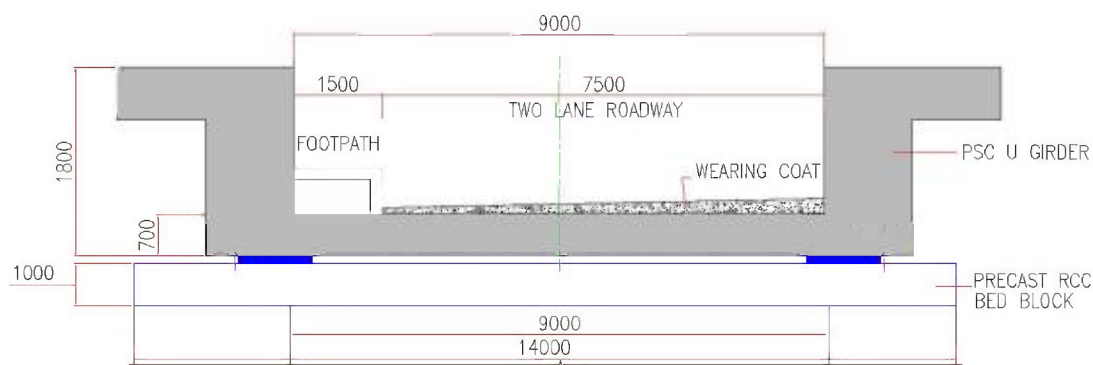
- Use steel composite girders & HSFG bolts at splices/field joints.
- Use reinforced earth retaining wall at approaches.
(which will give faster consolidation/compaction)
- Use open foundation to the extent possible, for the piers & abutments.
- Use precast segments for approach spans on viaduct.

II. Across new lines, GC – etc.

- i) Use 'U' type beam-cum-slabs to reduce the overall height & hence the total length of ROB considerably.

- ❖ 1^m reduction in height of deck level of ROB, will reduce the length of ROB by app. 50^m and cost by app. Rs.1.5 crores.
 - ❖ Overall height to be climbed by vehicles gets reduced & hence efforts.
 - ❖ No separate parapet wall/crash barrier is required as the side beams themselves will serve the same purpose.
- ii) Adopt circular/rectangular single column for the ROB.
 - iii) Precast Segmental Box girders cast by mass production at casting yards may be launched adopting double cantilever construction.

For elimination of number of LC in the gauge conversion sections, mass production of tapered segments may be made in central casting yard, transported to site and erected by road cranes. (Similar to viaduct span construction in Metro Railways).



SECTION OF PSC 'U' GIRDER

U TYPE GIRDER- TYPICAL CROSS SECTION

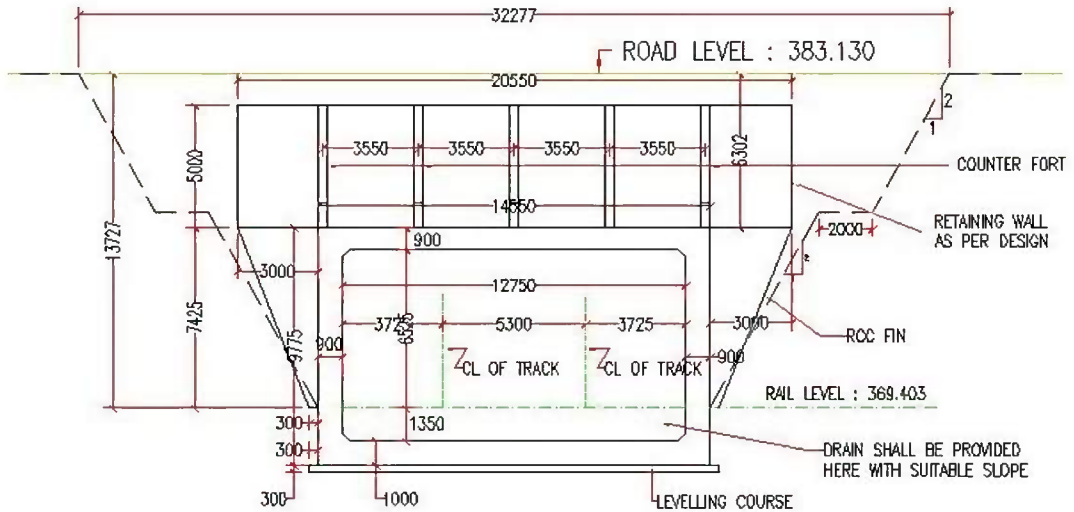
III. Across deep cuttings :

Use tunnel like RC box barrel & retaining wall above to support the road.

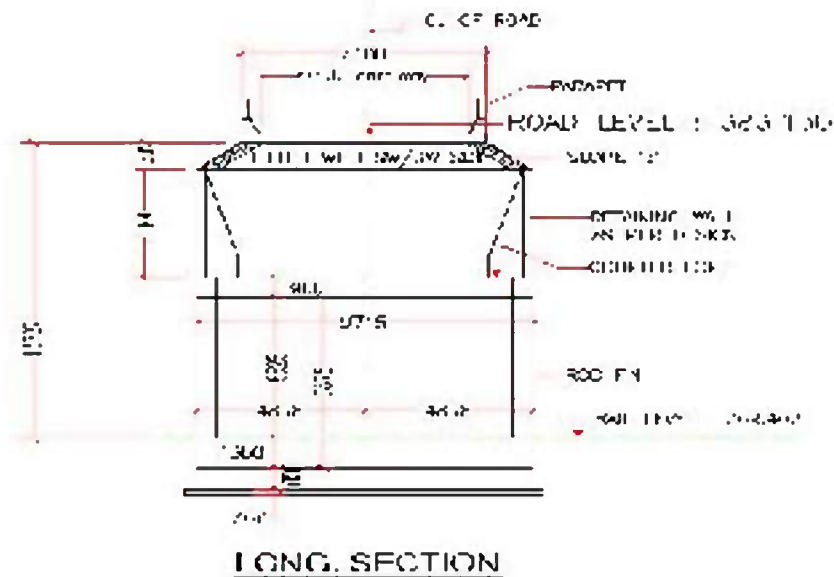
Advantages:

- ✚ Efficient structure suitable over all types of soil.
- ✚ Protect the slopes of the cutting against sliding & erosion.
- ✚ Economical section which is easy to construct.
- ✚ Due to RC base, track becomes stable & running is smooth.

- ✦ More efficient in deep cuttings & weak soils.



CROSS SECTION



IV. LUS along with ROB:

Whenever LUS is required at the same site of LC/ROB, the LUS shall be located below (or) adjoining the ROB. With ROB supported on single column, locating LUS, below the ROB will result in huge savings in cost of diversion, cost of reduced land required etc.

To reduce further the cost of LUS, height etc., the thickness of the top slab of RC Box shall be designed as a doubly reinforced section with a richer mix of concrete.

To reduce the width of RC box of LUS, tubular handrails shall be provided between roadway & pedestrian pathway instead of kerbs. As discussed below joint free long barrel may also be used.

(B) SINGLE LONG BARREL RUBs :

Introduction:

In road under bridge/subway construction under traffic condition, one of the following methods is invariably being used.

1. Erection of pre-cast RCC box units (segments) having the length of 1.5m each, by cut and cover method of construction.
2. Pushing of RCC pre-cast segments having length up to 6.0m – 8.0m by trenchless technology.
3. In-situ construction using RH girders.

An innovative idea of launching single precast segment of 14m length and any weight under cut and cover method of construction, which have number of advantages over any other method of construction & trend has been implemented in one of the subway (subway in lieu of unmanned level crossing no. 65D in AJJ – RU section at km 123/35-37) at Chennai Division of Southern Railway and the trial was successful.



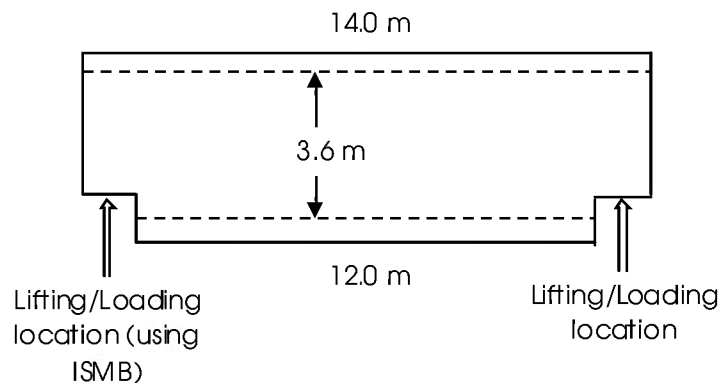
A- Frame arrangements – A Beginner

Novel Methodology adopted:

On completion of excavation for earth work for required depth and width under sufficient duration line block, Pushing the single unit box by loading over steel rollers at front and rear, pushing the RC box unit using suitable capacity pushing hydraulic jacks taking reaction (without thrust bed) from the weight of RC box unit itself which is resting on the rail nest laid below the single large barrel.

Casting of RCC box barrel (Joint free):

Single unit of RCC box of inner size 5.00m wide, 3.66m height and 14.0m long (Weight 385 tons) was casted at the same level & alignment of the proposed location of subway and at 8.0m away from the center line of track. The shape of the box was kept as shown in the sketch, considering the lifting/loading operations and providing rolling arrangements.



Lifting/Loading and rolling arrangements:

The RCC box unit was cast in such a way that the bottom slab and both side walls on either end have been left for 1m in length and 1.2m in height as groove. Two sets of built up steel beams perpendicular to the box have been kept below the cut portion of box wall. Rail nest with 52Kg rails were kept by the sides of RC box. The RCC box was lifted to the required height and support on the Roller inserted between Built up beam and Rail nest keeping 100mm clearance below the RCC box.



Rolling arrangements in front of RC box



Pushing operation

Pushing Arrangements:

Pushing jacks having 1m stroke length have been placed on the rail nest on behind either side of the RCC box duly fixing the anchorage brackets on the rail in order to get the reaction force from the RCC box loaded on the Rail nest itself. The jacks were connected with the suitable capacity power pack. (About 20% of the cost of subway has been saved by eliminating the casting of RCC thrust bed meant for pushing the RCC box).



Further Pushing using the spacers



Pushing arrangement (Rear View)
(Reaction for jacks taken from the rail nest installed for keeping the rollers)



Pushing in progress

During Line Block :

Slewing of OH wire was not involved, since there are no infringements to the OH equipment during the line block. Line block was obtained along with power block and earth work was done by excavators from other side of embankment for the required depth and size. Precast RCC base slabs have been kept as per the approved plan and the rail nests were extended as required.

The RCC box was pushed using hydraulic jacks kept in rear of the RCC box duly shifting the jack locations as required and finally lowered the RCC box at its location and removed the rolling arrangements and rail nests.

The sides of RCC boxes were finally filled with excavated earth and linked the track duly consolidating the filled earth and ballasting.

Post block works :

The RCC box subway was finished to shape and the approach road work was carried out along with construction of retaining wall. On completion of all the allied works, the subway was commissioned for use in a period of one month.

Savings on Cost :

Total Completion value of this RUB work is Rs. 1, 75, 00,000/-

<i>Erection by rolling (This method)</i>	<i>Pushing adopting separate thrust bed</i>	<i>Segmental erection with road crane</i>
<i>Expenditure for this method of launching</i>	<i>Cost of Ty, arrangements Rs. 3,50,000/-</i>	<i>Cost of erection at the rate of Rs.3,300/- per MT</i>
<i>Rs. 5,00,000/-</i>	<i>Cost of thrust bed Rs. 45,00,000/-</i>	<i>Rs. 16,50,000/-</i>
	<i>Total Rs. 48,50,000/-</i>	

Merits & Demerits of different methods of construction

Description	In situ construction	Pushing	Cut and Cover method	
			In segments	In single cast
Line block duration	Less in two or more spells	Not required	More in single spell	Less- comparing segmental construction
Duration of Speed restriction	Long period	Long period (little fast, if Ty. girder is used)	very less (one week)	
OHE	To be Slewed to erect the ty.Girder	Not required	To be lowered	Not required
Speed of construction	Slow and very slow in stage construction	Slow (little fast, if Ty. girder is used)	Very fast	
Line block duration	Less in two or more spells	Not required	More in single spell	Less- comparing segmental construction
Duration of Speed restriction	Long period	Long period (little fast, if Ty. girder is used)	very less (one week)	
OHE	To be Slewed to erect the ty.Girder	Not required	To be lowered	Not required
Speed of construction	Slow and very slow in stage construction	Slow (little fast, if Ty. girder is used)	Very fast	
Cost of Construction	Cheaper	Costly	Cheaper than pushing	Cheaper than segmental construction
Quality	The best	Fair	Moderate	The best
Skill requirement	Fairly required	Highly required	Not required	Required
Requirements of Equipments	No heavy equipments	Heavy – higher capacity jacks and crane for handling the segments	Cranes of suitable capacity & excavating equipments with standby	Preliminary works such as rolling/pushing arrangements - Excavating equipments & (No heavy duty crane)

