

**CENTRAL RAILWAY**



HEADQUARTERS OFFICE,  
ENGINEERING BRANCH,  
MUMBAI C.S.T.

No. W.187.R.A./XII/Circular

Date : 08.04.2021

**Sr.DEN(Co)BB,BSL,NGP,SUR,PA**

Sub: - Guiding limits of maximum cement content in concrete Mix Design for Railway structures and bridges. *PCE circular No. 208.*

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In connection with the above, please find herewith a copy of PCE's Circular No.208/2021 dated- 05.04.2021, regarding guiding limits of maximum cement content in concrete Mix Design for Railway structures and bridges for information and necessary action.

It is requested to kindly ensure compliance to the guidelines issued by above quoted PCE's Circular No.208/2021 while execution of work.

*3/3/21*  
**(A.K.Jain)** *08.04.2021*  
**Dy.CE(Works)**

DA: As above.

Copy to : 1. CPD/SD & CPD/BW }  
2. DRM/BB,BSL,NGP,SUR & PA } For kind information please.  
3. CTE,CE(PL),CBE,CE/TM,CE/TP, }  
CE/RSW,CE/G,CE/Workshop }



## CENTRAL RAILWAY

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CENTRAL RAILWAY

Principal Chief Engineer's Office,  
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### PCE Circular No 208/2021

No.W.187.R.A./XII/Circular

Date: 05.04.2021

***Sub: - Guiding limits of maximum cement content in concrete Mix Design for Railway structures and bridges***

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Concrete mix design provides an optimal mix of ingredients to provide required workability during placement and also to give hardened concrete which serves dual purpose of required strength and durability. For various grade of concrete, IRS Concrete Bridge Code:2014 and IS 456:2000 prescribe minimum cement content and maximum water-cement ratio depending upon environmental exposure condition for Railway bridge works and other civil works respectively. Above codes also prescribe maximum cement content for concrete. Owing to different dynamic and static nature of loadings for <sup>Railway</sup> bridges and buildings, these codes prescribe different values of ~~above~~ minimum & maximum cement contents.

In contracts, where item of concrete work is to be executed under USSOR, quantity of cement used in concrete is to be paid as an extra item as per Special Notes to Sr. No. 5 of Chapter 3 & 4 of USSOR-2011. Field Engineers are expected to perform due diligence in approval of concrete-mix design to achieve economy in cement content. Few instances have been reported where mix design have been finalized with higher w/c ratio and consequently higher cement content. On the contrary, in composite NS items of concrete, where cement is not to be paid separately, the cement content has been observed to be optimized to bare minimum.

Higher cement content, apart from being uneconomical, causes thermal shrinkage cracks and also adversely impacts environment. Instead of increasing w/c ratio, higher workability of concrete can be achieved by using suitable admixtures thereby keeping w/c ratio on lower side, so as to get concrete of adequate strength with reduced requirement of cement. Durable, impervious and high-performance concrete can be obtained through proper selection of ingredients, mix proportioning and using water reducing property of Super Plasticizers. USSOR items for RCC, provides for use of suitable admixture in mix-design.

In order to rationalize the cement in concrete mix design, based on the best construction practices adopted in the field, following guiding limits for Maximum cement content are hereby prescribed in concrete mixes of different grades, separately for Railway bridges and other structures:

**Table 1**

**Guiding limits of Maximum Cement Content in Concrete Mix for works of ROB/RUB/FOB/Subways /Water ways Railway Bridges: -**

Concrete Mix Grade	M 15	M 20	M25	M 30	M 35	M 40	M 45 & above
Maximum Cement Content (kg/cum)	315	350	380	410	440	475	500

**Table 2**

**Guiding limits of Maximum Cement Content in Concrete Mix for works of Building/PF Shelter Foundation etc:-**

Concrete Mix Grade	M 15	M 20	M25	M 30	M 35	M 40 & above
Maximum Cement Content (kg/cum)	300	330	360	390	420	450

**Special Notes:**

1. Mix Design shall be got done either from the reputed Govt. Engineering Degree Colleges or from the NABL approved Engineering Test Laboratories as per IS: 10262 and it shall be critically checked wrt. provisions of CBC or IS:456 as applicable.
2. All concrete mix designs shall be approved at level of Engineer-in-charge i.e. sectional DEN/Sr DEN/Dy CE.
3. While designing the concrete mix, the environment to which concrete may be exposed during its working life shall be judiciously decided. Very severe and Extreme exposure conditions shall be used with caution. The level of severity shall not be unreasonably high e.g. for RUB may not warrant Very severe or Extreme exposure conditions. While approving mix design, Engineer-in-charge shall apply due diligence to this aspect.
4. Depending upon exposure conditions, minimum grade of concrete, minimum Cement content and max w/c ratio in the Mix Design shall be applicable as per CBC or IS:456 as applicable. A summary of the codal provisions is given in Annexure in Table 3 and Table 4 for ready reference.



## Annexure

**Table 3**

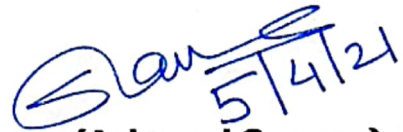
**Minimum Grade of Concrete Mix, Minimum Cement Content and Maximum W/C in concrete for works of ROB/RUB/FOB/Subways /Water ways Railway Bridges as stipulated in IRS: CBC 2014.**

Environmental Exposure	Parameters	For Structural members of PSC and Important Bridges			For Structural members of Other Bridges and Sub-structure		CBC:2014 Reference Clause
	Structural Member	PCC	RCC	PSC	PCC	RCC	
<b>Moderate</b>	Minimum Grade	M-25	M-30	M-35	M-15	M-20	Table 4(b), Cl. 5.4.4
	Minimum Cement(kg/m <sup>3</sup> )	240	300	400	240	300	Table 4( c ), Cl. 5.4.5
	W/C (Maximum)	0.50	0.45	0.40	0.50	0.45	Table 4(a), Cl. 5.4.3
<b>Severe</b>	Minimum Grade	M-30	M-35	M-40	M-20	M-25	Table 4(b), Cl. 5.4.4
	Minimum Cement(kg/m <sup>3</sup> )	250	350	430	250	350	Table 4( c ), Cl. 5.4.5
	W/C (Maximum)	0.45	0.40	0.40	0.45	0.40	Table 4(a), Cl. 5.4.3
<b>Extreme</b>	Minimum Grade	M-35	M-40	M-45	M-25	M-30	Table 4(b), Cl. 5.4.4
	Minimum Cement(kg/m <sup>3</sup> )	300	400	440	300	400	Table 4( c ), Cl. 5.4.5
	W/C (Maximum)	0.40	0.35	0.35	0.40	0.35	Table 4(a), Cl. 5.4.3

**Max cement content- 500kg/cum [Cl 5.4.5] Pl refer Table 1 for guiding limits**

5. *Maximum Cement Content for different grades of concrete has been given in Tables 1 & 2 above but every efforts must be made to reduce the cement content by trying different proportioning of constituent materials and use of permitted plasticizers.*
6. *Payment for cement shall be made as per the quantity approved in Mix Design.*

The Guiding limits mentioned in Table 1 & Table 2 above for Maximum cement contents are prescribed for strict compliance. In case, it is not feasible to design the concrete mix with above limits, then the mix design shall be referred to HQ along with material test reports and mix design calculations for its review and approval.

  
(Ashwani Saxena)  
PCE/C Rly

**Table 4**

**Minimum Grade of Concrete Mix, Minimum Cement Content and Maximum W/C in concrete for works of Building/PF Shelter Foundation etc as stipulated in IS 456:2000**

Environmental Exposure	Parameters	Structural Member		IS 456: 2000 Reference Clause
		PCC	RCC	
Mild	Minimum Grade	M-15	M-20	Table 5, Cl. 6.1.2
	Minimum Cement(kg/m <sup>3</sup> )	220	300	Table 5, Cl. 8.2.4.1
	W/C(Maximum)	0.60	0.55	Table 5, Cl. 8.2.4.1
Moderate	Minimum Grade	M-15	M-25	Table 5, Cl. 6.1.2
	Minimum Cement(kg/m <sup>3</sup> )	240	300	Table 5, Cl. 8.2.4.1
	W/C(Maximum)	0.60	0.50	Table 5, Cl. 8.2.4.1
Severe	Minimum Grade	M-20	M-30	Table 5, Cl. 6.1.2
	Minimum Cement(kg/m <sup>3</sup> )	250	320	Table 5, Cl. 8.2.4.1
	W/C(Maximum)	0.50	0.45	Table 5, Cl. 8.2.4.1
Very Severe	Minimum Grade	M-20	M-35	Table 5, Cl. 6.1.2
	Minimum Cement(kg/m <sup>3</sup> )	260	340	Table 5, Cl. 8.2.4.1
	W/C(Maximum)	0.45	0.45	Table 5, Cl. 8.2.4.1
Extreme	Minimum Grade	M-25	M-40	Table 5, Cl. 6.1.2
	Minimum Cement(kg/m <sup>3</sup> )	280	360	Table 5, Cl. 8.2.4.1
	W/C(Maximum)	0.40	0.40	Table 5, Cl. 8.2.4.1

**Max cement content- 450kg/cum [Cl 8.2.4.2] Pl refer Table 2 for guiding limits**