Early Prediction of RCC Dam Body Permeability during construction; Case Study: Dyraaba Dam, Sri Lanka

by

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- Roller compacted concrete (RCC) has become a popular material in recent decades for dam and pavement design, Because of higher speed of construction and lower cost.
- Roller compacted concrete (RCC), same as convectional concrete (CVC), is a mixture of coarse and fine aggregates, water, cementitious materials and required admixtures, with no-slump consistency in its unhardened situation.
- In dam design, permeability is one of the parameters with an utmost importance.
- In this paper density of fresh concrete, compressive strength and Vebe-Time of RCC have been used to early prediction of permeability RCC.

Previous Studies on RCC:

- Taha Mehmannavaz et al. (2012) studied the permeability of the mass of RCC mixture used in one of the largest RCC dam located in south of Iran.
- C.Chhorn et al. (2017) investigated the variation of quality of RCC based on its consistency.
- Chamroeun Chhorn et al. (2018) developed an equation to evaluate the relationship of compressive and tensile strengths of RCC and compare it with CVC.

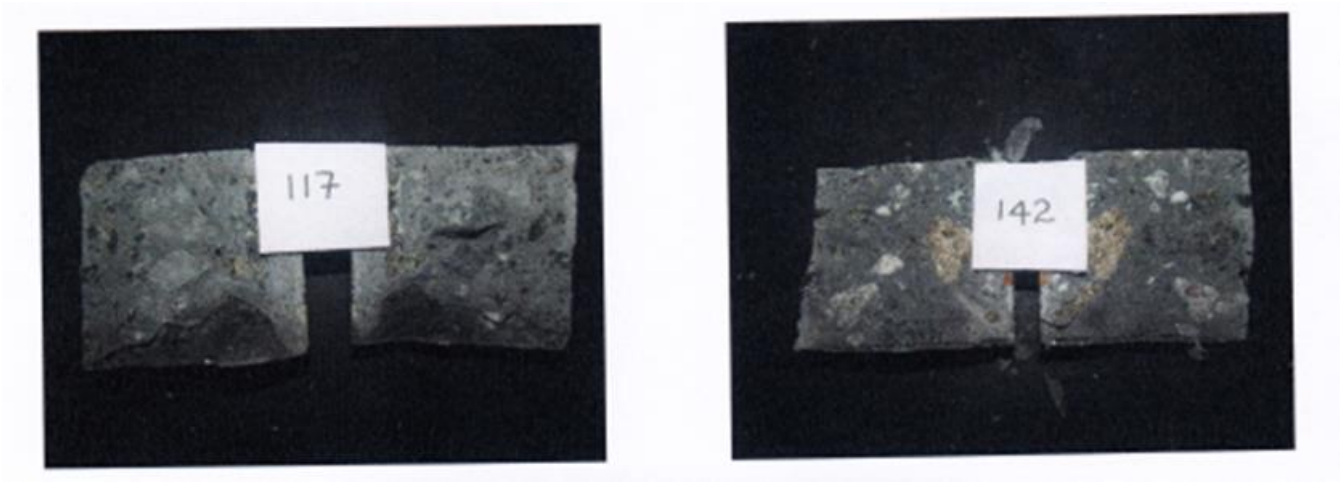
Case Study:

- Dyraaba dam is a RCC dam that is located in Uva province, Srilanka
- This dam is designed for the aim of providing agriculture and water transmission to underground hydropower plant powerhouse through a conveyance tunnel with length of 15.5 Km.
- Dam reservoir capacity: 0.970 MCM
- Dam body's concrete volume: 105000 m^3
- Installed capacity of powerhouse: 2x60 MW

Location of Dyraaba dam in Sri Lanka

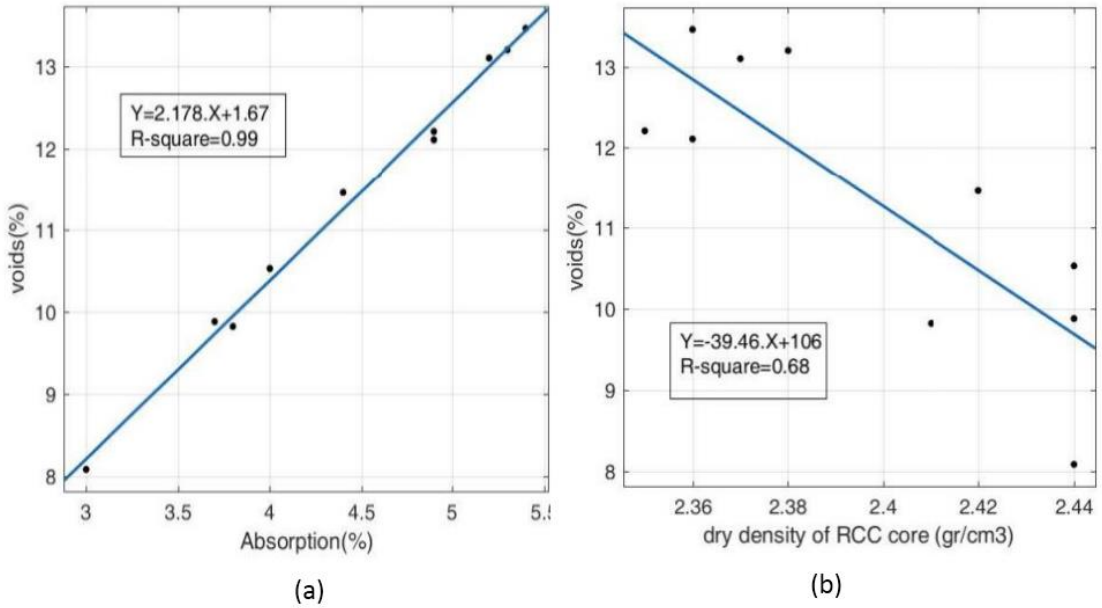
- In this study, the impact of Vebe time, density and compressive strength of RCC is used to evaluate and predict impermeability of Dyraaba dam's body.
- Vebe consistency is an indicator of the workability of RCC and is determined by ASTM C 1170,"Standard Test Method for Consistency and Density of Roller-Compacted Concrete Using a Vibrating Table".
- Absorption, porosity and density of RCC cores are determined according to ASTM C642 (Standard Test Method for Density, Absorption and Voids in Hardened Concrete).

- Depth of water penetration in obtained RCC cores from dam body has been determined from BS EN 12390-8 (Depth of penetration of water under pressure).

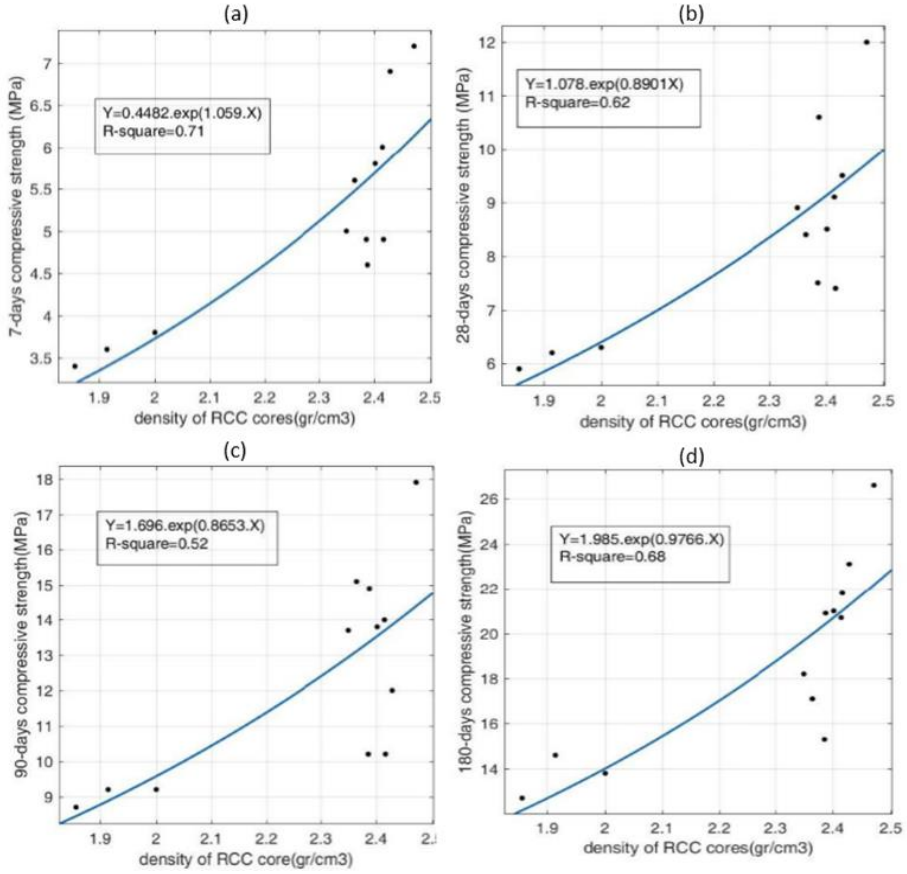


Test specimens after splitting into halves

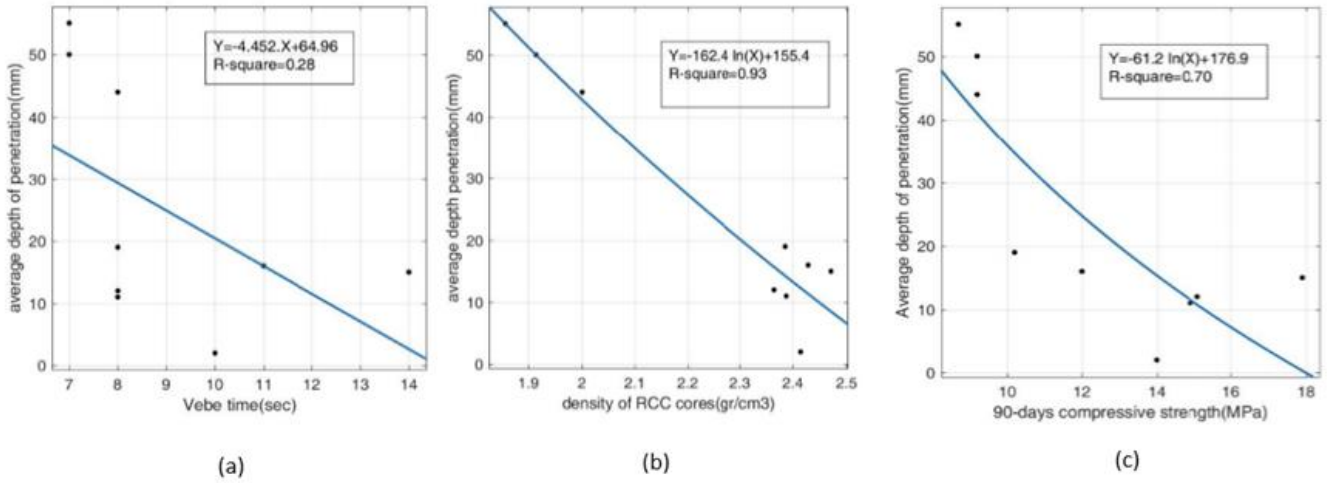
Results:



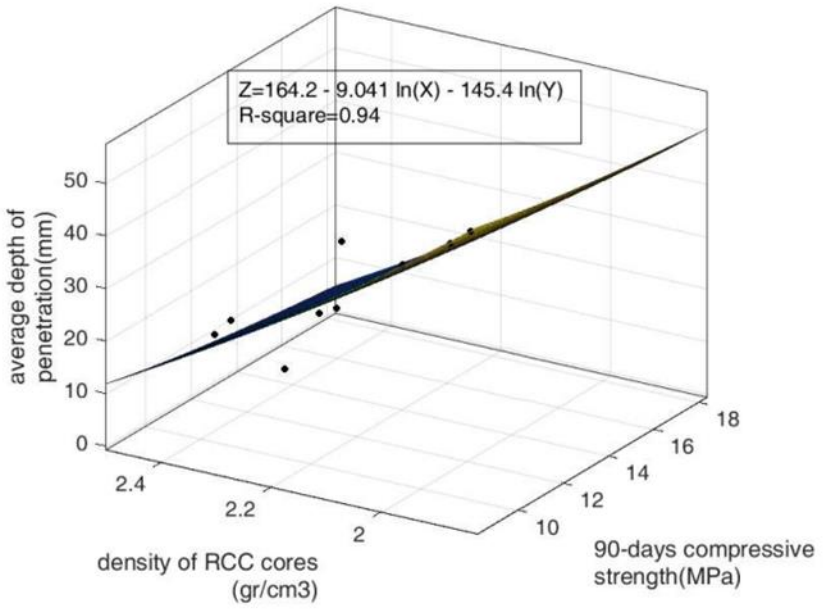
(a) Relation between porosity and water absorption. (b) Relation between porosity and dry density of RCC cores.



- Relation between density of RCC cores and compressive strength in different ages is shown.
- Relations and are logically compatible with our knowledge about roller-compacted concrete and prove the accuracy of our experiments.



Data analysis shows that there is no significant relation between Vebe time and average depth of penetration (figure a). However, density and compressive strength remarkably effect on the depth of penetration.



z=164.2-9.041×ln(x)-145.4×ln(y), R^2=0.94

Based on results, it is logical to predict the amount of permeability by use of a multi-variable function. Because of the higher correlation coefficient in figure (b and c), this equation is developed fit an appropriate curve and estimate average depth of water penetration.

$$z = 164.2 - 9.041 \times \ln(x) - 145.4 \times \ln(y)\,, \qquad R^2 = 0.94$$

Conclusion:

- In predicting RCC Permeability the most important property is compressive strength, next one is density and the component with lowest impact is Vebe time.
- This equation can indicate RCC permeability very soon that can led to modify mix design or method of , save time, reduce costs and uncertainties.

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