

# Studi mengenai pengaruh umur terhadap korelasi kuat tekan dan cepat rambat gelombang ultrasonik pada beton daur ulang dengan metode digital image correlation analysis = Study on the effect of age on concrete compressive strength and ultrasonic pulse velocity on recycled concrete with digital correlation image analysis method

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## Abstrak

Penelitian ini membahas hubungan cepat rambat gelombang ultrasonik dengan kuat tekan dan pola retak beton daur ulang. Pengujian cepat rambat gelombang ultrasonik (UPV) dilakukan menggunakan PUNDIT. Pengamatan pola retak menggunakan metode digital image correlation (DIC). Benda uji yang dibuat adalah 16 kubus ukuran 15 cm dan 4 balok ukuran 15x15x50 cm. Spesimen kubus diuji tekan di umur 3, 7, 14, dan 28 hari dan di umur 28 disertai metode DIC. Pengujian metode DIC menggunakan kamera Fuji Film XA-3 dan diolah dengan software Ncorr pada MATLAB. Benda uji balok diuji UPV setiap jamnya di 24 jam pertama dan setiap hari sampai umur 28 hari. Penelitian ini menghasilkan hubungan logaritmik antara nilai UPV dan umur beton daur ulang dengan persamaan tiap benda uji sebagai berikut,  $VA = 2.68745E+02\ln(x)+1.92197E+03$ ,  $R^2=0.809$ ,  $VB = 2.75780E+02\ln(x) + 1.82082E+03$ ,  $VC = 3.51058E+02\ln(x) + 1.59413E+03$ , dan  $VD = 3.51448E+02\ln(x) + 1.61130E+03$  dengan nilai  $R^2$  sebagai berikut,  $RA^2 = 0.809$ ,  $RB^2 = 0.844$ ,  $RC^2 = 0.762$ , dan  $RD^2 = 0.772$ . Dihasilkan hubungan eksponensial antara kuat tekan beton dan nilai UPV dengan persamaan  $f_c = 1.58593E01e1.22057E+00V[m/s]$  dengan nilai  $R^2 = 7.36785E-01$ . Hasil pengujian metode DIC menunjukkan evolusi deformasi vertikal dan horizontal serta evolusi pola retak dari beton daur ulang. Stiffness tiap benda uji sebesar  $B = 862.92 \text{ kN/mm}$ ,  $C = 902.21 \text{ kN/mm}$ , dan  $D = 1018.22 \text{ kN/mm}$ . Poisson ratio dari benda uji sebesar  $B = 0.2478$ ,  $C = 0.2302$ , dan  $D = 0.2392$ .

This research will conduct a discussion about relationship between ultrasonic pulse velocity and compressive strength along with crack pattern of recycled concrete. Ultrasonic pulse velocity (UPV) will be measured using the PUNDIT. Observation of crack patterns using digital image correlation (DIC) method of recycled concrete. The specimens to be made are 16 cubes with dimension of 15cm and 4 beam with dimension of 15x15x50 cm. Cube specimens aged 3, 7, 14, and 28 days will be tested and on the day 28 will use DIC method. DIC method use Fuji Film XA-3 as to capture pictures which will be processed with Ncorr on MATLAB. Beam specimens will be used for UPV test within every hour in the first 24 hours and every day up to 28 days. This study results show logarithmic relationship between the UPV and the age of recycled concrete with the result equation each specimen as follows,  $VA = 2.68745E + 02\ln(x) + 1.92197E + 03$ ,  $VB = 2.75780E + 02\ln(x) + 1.82082E + 03$ ,  $VC = 3.51058E + 02\ln(x) + 1.59413E + 03$ , and  $VD = 3.51448E + 02\ln(x) + 1.61130E + 03$  with the coefficient of determination of each specimen as follows,  $RA^2 = 0.809$ ,  $RB^2 = 0.844$ ,  $RC^2 = 0.762$ , and  $RD^2 = 0.772$ . Exponential relationships shown between concrete compressive strength and UPV in equation of  $f_c = 1.58593E01e1.22057E + 00V [m / s]$  with  $R^2 = 7.36785E-01$ . The DIC test results show the evolution of vertical and horizontal deformations as well as the evolution of crack patterns of recycled concrete. Stiffness of each specimens as follows,  $B = 862.92 \text{ kN / mm}$ ,  $C = 902.21 \text{ kN / mm}$ , and  $D = 1018.22 \text{ kN / mm}$ . Poisson ratio of each specimens as follows  $B = 0.2478$ ,  $C = 0.2302$ , and  $D = 0.2392$ .