Evaluation of durability of concrete substituted heavyweight waste glassas fine aggregateIl Sun Kim a,1, So Yeong Choi a, Eun Ik Yang a,?article infoArticle history:Received 12 January 2018Received in revised form 8 June 2018Accepted 27 June 2018Keywords:Heavyweight waste glassDurabilityWater absorptionFreezing and thawing resistanceSulfate attackChloride ion penetrationabstractConcrete is the most widely used construction material, and huge amounts of natural resources arerequired to manufacture it. With relatively recent rapid industrial development as well as the improve-ment of people's living standards, the volume of domestic and industrial waste is increasing, and much ofthis waste is not recycled.Construction and Building Materials 184 (2018) 269-277Contents lists available at ScienceDirectConstruction and Building Materialsjournal homepage: www.elsevier.com/locate/conbuildmatIn particular, since 2012, when analog TV broadcasting ended,and systems converted to digital TV broadcasting in South Korea,a large volume of cathode ray tube (CRT) TVs and monitors werediscarded and replaced with LCD panels.Just asnotable is that most of the old CRT TVs and monitors are not recy-cled despite the fact that parts, including the CRTs, can be. CRTglass products are classified into panels and funnels, wherein thepanels may be reused as glass after washing, but the funnels, con-taining a large number of heavy metals such as iron and lead, aredifficult to treat using conventional recycling technology.Referring to the electrical accelerated migration test suggested by Tang andNilsson (ASTM C 1202 (2012)) [39], a chloride ion penetration test was performedby applying a voltage of 30 V for eight hours with a 0.3 M NaOH solution as a pos-itive electrode (+) and a 3% NaCl solution as a negative electrode ( ).Conditions VariablesW/B (%) 35, 45, 55Heavyweight waste glasssubstitution ratio (%)0, 50, 100Specimen size (mm) O100 200 (Compressive strength)O100 200 (Water absorption ratio)O100 200 (Sulfate attack)O100 50 (Chloride ion penetration)100 100 400 (Flexural strength)100 100 400 (Freeze-thaw resistance)Curing condition Water curing (20 +- 3 C)Curing days 7, 28, 91Table 4Mix proportion of concrete.The results also showed that the diffusion coefficient greatlydecreased as the waste glass substitution ratio increased, espe-cially at a high W/B ratio, indicating that the chloride ion penetra-tion resistance was effectively improved.aDepartment of Civil Engineering, Gangneung-Wonju National University, 7, Jukheon-gil, Gangneung-si, Gangwon-do 25457, Republic of Koreahighlights Cathode ray tube (CRT) waste glass was recycled as fine aggregate of concrete.Waste CRT glass containingheavy metals was recycled as fine aggregate for concrete; the durability of the concrete was investigatedby performing freeze-thaw resistance, sulfate attack, and chloride ion penetration measurement.Inaddition to heavyweight aggregate, many researchers have studiedthe properties and radiation shielding performance of concretemixed with lead mine waste, waste marble, recycled aggregate,electric arc furnace slag, ferrochromium slag, barite, and minerals[22-30].Chemical composition (%)SiO2 Al2O3 Fe2O3 Cao MgO SO3 LOI21.36 5.03 3.31 63.18 2.89 2.30 1.40Physical propertiesSpecific gravity Blaine (cm2/g) Initial setting time (min) Final setting time (h) Compressive strength (MPa)3 Days 7 Days 28 days3.15 3750 255 6:30 34 43 53Table 2Material properties of aggregate.[24] W. Gallala, Y. Hayouni, M.E. Gaied, M. Fusco, J. Alsaied, K. Bailey, M. Bourham,Mechanical and radiation shielding properties of mortars with additive fineaggregate mine waste, Ann.The specimens for the test of the freezing and thawing resistance andflexural strength were prepared as rectangular columns with a size of 100 100 400 (mm), while those for the sulfate attack test, the chloride ion penetrationtest, compressive strength, and water absorption ratio were prepared as cylinderswith a size of O100 200 (mm).[25] D.H. Han, W.J. Kim, S.K. Lee, H.Y. Kim, P. Romero, Assessment of gammaradiation shielding properties of concrete containers containing recycledcoarse aggregates, Constr.[26] M. Maslehuddin, A.A. Naqvi, M. Ibrahim, Z. Kalakada, Radiation shieldingproperties of concrete with electric arc furnace slag aggregates and steel shots,Ann. Durability of concrete containing CRT glass was investigated.Materials2.1.1.1.?1.1.2.2.1.2.2.1.3.2.3.4.2.1.4.2.1.5.2.2.2.2.2.2.2.3.2.3.4.5.6.3.3.2.7.8.3.3.9.10.11.12.11.12.3.4.3.5.13.14.3.6.4.15.16.17.