Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 173 (2017) 447 – 454

Procedia Engineering

www.elsevier.com/locate/procedia

11th International Symposium on Plasticity and Impact Mechanics, Implast 2016

Behaviour of adhesive bonded and mechanically connected steel-concrete composite under impact loading

Pankaj Kumar[a], Sandeep Chaudhary[a,*], Rajesh Gupta[a]

[a] *Department of Civil Engineering, Malaviya National Institute of Technology Jaipur, Jaipur-302017, India*

Abstract

The aim of the study was to observe and provide a qualitative comparison of the behaviour of mechanically connected and adhesively bonded steel-concrete composite connections under impact load. For this, steel-concrete composites connections were subjected to drop-weight impact test. The number of blows required for crack initiation and final failure (serviceability failure in case of the stud connection) were noticed. It was found that the adhesively bonded connection can resist comparatively higher number (twice) of blows for crack initiation but, the number of blows required for final failure were relatively less. The adhesively bonded connection showed a brittle failure in concrete near the adhesive concrete interface whereas the mechanically connected specimen showed ductile failure due to concrete crushing in composite specimen nearby the studs.

Peer-review under responsibility of the organizing committee of Implast 2016

Keywords: Steel, concrete, composite, adhesive, stud, push out test, drop-weight;

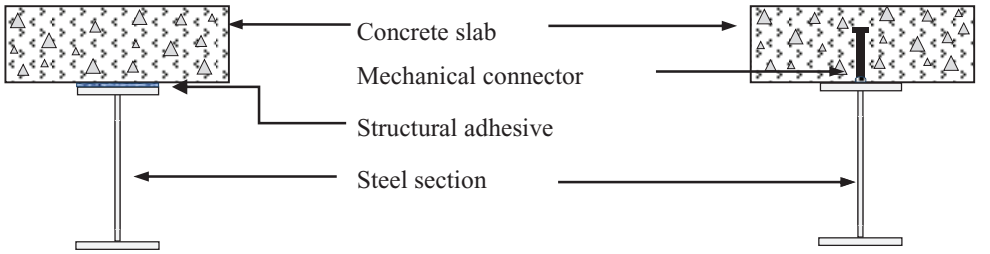
1. Introduction

The steel–concrete composite member is stiffer and stronger than steel beam and concrete slab alone. The main hindrance being connection at steel–concrete interface. The performance of the composite member strongly depends on connection between steel beam and concrete slab [1,2]. Connection at steel-concrete interface must be able to resist the applied load and capable of transferring stresses from one to another. The efficiency of composite connection depends on the degree of interaction between the steel and concrete. The degree of interaction depends

* Corresponding author. Tel.: +91-141-2713273; fax: +91-141-2713388.
E-mail address: schaudhary.ce@mnit.ac.in

Peer-review under responsibility of the organizing committee of Implast 2016
doi:10.1016/j.proeng.2016.12.062

on shear stiffness of composite connection. The degree of interaction and degree of shear connection are directly related. Degree of interactions is evaluated by relative slip induced at composite interface. On the basis of relative slip at the interface of steel-concrete composite connections, they can broadly classified as flexible, semi-rigid and rigid connections. Mechanical connectors, which have relatively higher value of slip such as stud, angle, channel, perfobond etc. are considered as flexible or semi-rigid connection and adhesively bonded connections are considered as rigid connection. Fig.1 shows a schematic cross-sectional view of mechanically connected and adhesive bonded steel- concrete composite beams.



(a) Mechanical stud connected composite beam (b) Adhesive bonded composite beam

Fig. 1.Cross-section view of mechanical connected and adhesive bonded steel-concrete composite beam

The behaviour of steel-concrete composite connection has been broadly investigated in several studies. Mechanical stud connectors are common in steel-concrete composite connections. An exhaustive study on monotonic and cyclic loading on stud connectors has been carried out by numerous researchers [2-7]. Adhesive bonded steel-concrete composite connections are still new for civil engineering applications. Few studies have been conducted on adhesive bonded connection during last decade [8-12].

Recent increase in vehicular accidents imposed prominent danger to the public civil infrastructure. Thus, the impact resistant design of structures has increasingly attracted the research community during last decade [13-16]. Steel-concrete composite bridges are typical public structures which resist impact loading, often owing to vehicular impact, ship impact, aircraft impact etc. Impact loading is generally a concentrated loading, which usually lies in the range of 10^1 s^{-1} [17]. Behaviour of composite specimen under impact load is entirely different compared to behaviour under monotonic loading. The impact strength of a composite member depends on both structural resistance and energy absorption capacity of the member. Impact test can be divided into two parts: large mass with low velocity and small mass with high velocity. Large mass with low velocity include tests like drop-weight, Charpy test and Izod test. The drop-weight test is preferred over other methods of impact testingas it offers highest flexibility in terms of specimen geometry. ACI Committee 544 [18] recommends drop-weight impact test on conventionally mixed and placed fibre reinforced concrete (FRC) or fibre reinforced shotcrete (FRS) using steel, glass, polymeric, and natural fibres.

Nomenclature

m	mass of drop impacter (kg)
g	earth gravitational acceleration (9.81 m/s^2)
h	releasing height of impacter (metre)
N_1	number of blows required for cracks initation
N_2	number of blows required for final failure
$E_{dw,i}$	impact energy of impacter at crack initation (Joules)
$E_{dw,u}$	impact energy of impacter at ultimate failure (Joules)