MECHANICAL STUDY ON STEEL-CONCRETE-STEEL(SCS) SANDWICH COMPOSITE BEAM- A REVIEW

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ABSTRACT
`The use of sandwich structure is increased rapidly in various field which uses many applications ranging from satllite,ships,automobilers,bridge construction and many more.Steel-concrete –Steel used in modern industry ,where shear connectors are commonly welded through the profiled steel sheeting to ensure full/partial composite action between the beam and composite slab. This paper reviews mechanical behaviour of steel- concrete-steel sanwich composite beam. This reviews shows detail investigation on various shear connecters .To review the mechanical property and strength aspect of shear connecter. The review result show the various shear connector used in the steel-concrete- steel composite beam.

CONTENTS:

1.INTRODUCTION

Steel-Concrete-Steel (SCS) sandwich comprises a central concrete core which is sandwiched between two steel skins to form a composite unit whose behaviour is greatly influenced by the interfacial bond between the two materials. During the past 30years there have been many research and development in SCS sandwich construction. cohesive bonding material (e.g. epoxy) and different types of mechanical shear connectors such as headed stud, J hook, Bi - steel connectors, angle shear connectors, plate connectors etc., was proposed to bond the steel plate and the concrete core.

Considering the existing SCS system, commonly used shear connectors is headed stud and J hook connectors were investigated experimentally in the researches. Light weight concrete (LWC) and high performance Ultra Lightweight Cement Composite (ULCC) materials were used as a core material.

2. SHEAR CONNECTORS

A Shear connector is a steel projection provided on the top flange of steel composite bridge girders to provide necessary shear transfer between the steel girder and composite slab to enable composite action.The requirements of shear connectors are Providing interface slipping resistance.Preventing complete pull out from the concrete core.Enhancing the cross section shear resistance to resist vertical load. The most widely used form of shear connector is the headed stud or shear stud. A stud that transfer shear strees between steel and concrete oin composite structural member in which stud is welded ti the steel plate. The behaviour of shear connector depends on the typical shear connection in composite structure.

3.OBJECTIVE AND SCOPE OF THE INVESTIGATION

Objective

- To determine the flexure strength of the composite beam by two-point laoding or three-point loading.
- To qualify shear connectors for practical use in composite beam pushout test is carried out.
- To determine the ultimate strength and deformation capacity of the shear connectors.
- To compare the strength behaviour of various shear connectors.

Scope

- The load carrying capacity of the composite beam is increased .
- The shear resistance of the shear connectors is analysed
- Shear connectors provide good interaction between steel plate and concrete core..

4.Literature Review:

R.Mark Lawson, HogrTaufiq(2019) has invested the partial shear connection in light steel composite beams,A new form of light steel composite beam has been developed that uses C sections acting in tension with shear connectors inthe form of screws or bolts or perforations in the web of the C section. The shear and bending resistance is also increased by using side C sections to the beams. Bending tests on point-loaded beams of 0.8,1.1 and 1.7mspan showed that for the short span beams, the longitudinal shear bond strength of the base C sectionsis 1.4 N/mm2 for plain C sections and 2.3 $N/mm^2$for perforated Csectionswhen expressed over the horizontalplane. Plain side C sections added 80% and perforated side Cs added 130% to the load-bearing capacity of thecomposite beamswith base Cs. The theory is extended to cover elastic design taking account of partial shear connection in which the shear stiffness of the perforated web of the C section is approximately 10 N/mm^3(per unit web area) and that of the plain web is approximately 3 N/mm^3
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QuanquanGuo, Weiyi Zhao (2019)investigated the design of steel-concrete composite walls subjected to low-velocity impact,Steel-concrete composite (SC) walls are composed of two steel plates and a concrete core. Experiments have shown that SCwalls have excellent resistance to impact loadings, which is a great advantage for the applications in safety-related nuclear facilities. This paper presents an energymethod for evaluating themaximum deformationof SC walls under low-velocity impact. The design requirements and flow for SC walls are proposed in three aspects: (i) local failure, (ii) maximum deformation, and (iii) damage degree. The parameters affecting the local failure and damage degree are discussed. The design method is applied to a sample SC wall in the AP1000 nuclear facility to validate its feasibility and provides a simplistic tool for researchers and engineers.

Luciano M.Bezerra, OtavioO.Cavalcante, LatifChater, Jorge Bonilla (2018) studied the Shear connectors are fundamental components for composite steel-concrete beams. Their function is to bring about a good degree of interaction between the concrete slab and the steel profile. The stud bolt connector is currently themost adopted solution,mainly because of its high productivity and practicability on construction sites. However, there are situations where stud bolts or the appropriate equipment for their application may not be available. Alternative shear connectors can substitute stud bolts. In this article, a new V-shaped shear connector is proposed. It was conceived to confine concrete in a larger frontal contact area and be easy to install and construct. With more contact area, the proposed connector distributes the shear force more uniformly, avoiding high stress concentration compared to the stud bolt option. The V-shaped connector has a higher moment of inertia. It is less flexible than stud bolts and U-connectors under bending. In this research, different V-shaped connectors, with varying thicknesses, are studied experimentally and numerically with push-out tests and FE modelling. The results are compared to standard stud bolts and show that the proposed V-shaped connector may be utilized as an alternative shear connector in composite steel-concrete beams

UtsabKatwal, Zhong Tao, MdKamrul Hassan (2018) investigated the Finite element modelling of steel-concrete composite beams with profiled steel sheeting,Steel-concrete composite beams have been widely used in modern construction industry, where headed shear stud connectors are commonly welded through profiled steel sheeting to ensure full/partial composite actionbetween the beam and the composite slab. For such composite beams, there are complex interactions between different components, leading to different failure modes. Finite element (FE) analysis could be used to understand the fundamental behaviour of such beams. But previous FE models have adopted various assumptions to simplify the modelling of some complex interactions such as the interaction between the shear studs and concrete. Accordingly, those FE models have limitations to capture certain types of failure modes. Meanwhile, the actual forces carried by the studs and profiled steel sheeting have not been quantitatively determined. In this context, this paper aims to develop a detailed FE model for composite beams with profiled steel sheeting by considering realistic interaction between different components, fracture of the shear studs and profiled steel sheeting, as well as tensile and compressive damage in concrete. The developed FE model can satisfactorily predict the full-range load–deformation curves of the composite beams and the shear force–slip relationship of the embedded shear studs. The predictions agree very well with a wide range of test data reported in the literature.

Xiaohu Li, Xiaojun Li (2017) investigated the Steel plates and concrete filled composite shear walls related nuclear structural engineering: Experimental study for out-of-plane cyclic loading, Based on the program of CAP1400 nuclear structural engineering, the out-of-plane seismic behaviourofsteel plate and concrete infill composite shear walls (SCW) was investigated. 6 1/5 scaled specimens were conducted which consist of 5 SCW specimens and 1 reinforced concrete (RC) specimen. The specimens were tested under out-of-plane cyclic loading. The effect of the thickness of steel plate, vertical load and the strength grade of concrete on the out-of-plane seismic behaviour of SCW was analysed. The results show that the thickness of steel plate and vertical load has great influence on the ultimate bearing capacity and lateral stiffness, however, the influence of the strength grade of concrete was little within a certain range. SCW is presented to have a better ultimate capacity and lateral stiffness but have worse ductility in failure stage than that of RC. Based on the experiment, the cracking load of concrete infill SCW was analysed in theory. The modified calculation formula of the cracking load was made, the calculated results showed good agreement with the test results. The formula can be used as the practical design for the design of cracking loads.

Aizhu Zhu, Xiaowu Zhang, Hongping Zhu, Jihua Zhu, Yong Lu (2017)studied an experimental programme was conducted to investigate the compressive behaviour of concrete-filled coldformedsteel tubular (CFCFST) stub columns with thicker tubes. A total of 30 CFCFST stub columns were tested. The cold-formed square hollow section (SHS) tubes included unstiffened sections and longitudinally inner-stiffened sections using different stiffening methods. Two tubular thicknesses of 6mm and 10mm were considered. The overall nominal dimension of the steel section was 200 × 200 mm, and the length of the stub columns was 600mm. Normal concrete and self-consolidating concrete with a nominal compressive strength of 30 MPa were used to fill the cold-formed SHS steel tubes. The effects of the stiffeners on the rigidity, ductility, failure mode and average sectional strength of the CFCFST specimenswere examined. The measured strengths of the CFCFST specimens were also comparedwith the predicted capacities using methods in various codes including AISC, BS5400, EC4, and DBJ and from a finite element (FE) analysis. Results demonstrate that the inner stiffeners affect the deformability, failure mode and overall strength of the stub columnswith the 6mm-thick tubes more significantly.The DBJ code method is comparatively the best in predicting the strength capacity. Using the validated FEmodel, an extended analysis hasbeen conducted and this has provided further insight into the mechanical behaviour of the CFCFST specimens.

J.Y. Richard Liew,Jia-Bao Yan , Zhen-Yu Huang (2017)
This study investigated the Steel-concrete-steel (SCS) sandwich structures consisting of two steel face plates infilled with lightweight cementcomposite material has been developed. This paper reviews the recent innovations of SCS sandwich structuressubject to blast, impact, fatigue, and static loads. Novel J-hook connectors, high strength steel plates andnew lightweight cement composite materials have been considered for the development of the SCS sandwichproducts to improve their strength-to-weight performance. Extensive tests have been conducted to investigatethe effectiveness of J-hook connectors to achieve better composite action to resist

flexural, shear, impact, blastand fatigue loads. Flat and curved SCS sandwich plates under patch loading are also investigated. The experimentalresults are essential to understand the structural behaviour of the SCS sandwich structures and to provide datafor the development of analytical models for design implementation. Design equations have been proposed topredict the shear and tensile resistances of J-hook connectors and to determine the flexural, shear, impact,blast and fatigue resistances of SCS sandwich beam. The punching shear resistance of sandwich shells and compressionresistance of sandwich walls are also investigated. The accuracy of the design equations are validated bythe test data and finite element analysis results.

LengYu-Bing, SongXiao-Bing(2017)

This study investigates the Composite beams comprising of concrete slabs and steel beams joined by conventional headed stud shearconnectors are commonly used in modern steel-framed building construction. However, because theheaded stud shear connectors are welded onto the top flange of the steel beam and cast into thein situ concrete slab, deconstruction of the composite beam and the reuse of its components at the endof structural life in defense to demolition is virtually impossible, which is at odds with the increasingdemands placed on improving the sustainability of building infrastructure. As an alternative, an innovativesustainable composite beam and slab system is proposed, in which precast geopolymer concrete panelsare attached to the steel beams using high-strength friction-grip bolts instead of cast in situ floors withpre-welded headed stud connectors. The advantages of a low-carbon design, both by the use of geopolymerconcrete elements and system deconstructability, can be achieved in this proposed system. In thispaper, a three-dimensional finite element model is developed to investigate the structural behavior of the proposed sustainable composite beam and slab system. Material non-linearities and the interaction
of the structural components are included in the model. The accuracy and reliability of the finite elementformulation developed are validated by comparisons with experimental results. Extensive parametricstudies are conducted to elucidate the effects of the change in the concrete panel configuration, the numberand diameter of the bolts, the type and strength of the concrete and the grade of the steel beam on thebehavior of the system. The use of modified rigid plastic analysis is assessed, and a modification is suggestedto predict the flexural strengths of the composite beams and slab system.A theoreticalmodel is developed to predict the resistance of SCS slabs under concentrate loads. The flexural capacity is calculatedwith the yield-line method, and the punching shear resistance is analyzed with the radial sector model. Theshear contribution of the tie bars is also analyzed experimentally and theoretically.

Ehab C. Karama, Rami A. Hawileha, Tamer El Maaddawyb, Jamal A. Abdallaa(2017)

This paper investigates the flexural performance of pre-damaged steel-concrete composite beams repaired usingexternally-bonded carbon fiber-reinforced polymer (CFRP) laminates with and without mechanical anchors. Atotal of 10 beams were prepared, one beam was left undamaged, whereas nine beams were artificially damagedby cutting different U-shaped notches in the bottom flange at the beams' mid-span that resulted in 45%, 73% and100% losses in the flange thickness. Three damaged beams were not strengthened, whereas six damaged beamswere repaired in flexure using externally-bonded CFRP laminates with and without mechanical anchors. Theload-carrying capacities of the unstrengthened beams with damage states of 45%, 73% and 100% wereapproximately 11%, 23%, and 50% lower than that of the control-undamaged beam, respectively. The CFRPrepair schemes were capable of restoring the original load capacity of the damaged beams with the lowerdamage state of 45%. For the beams with the higher damage states of 73% and 100%, the repair schemes couldrestore a maximum of 81% of the original load capacity. The inclusion of mechanical anchors in the repairregime improved the strength gain from 15% to 19% and from 46% to 63% for the beams with 45% and 100%damage states, respectively, relative to the strength of the corresponding damaged-unstrengthened beam.

Xinpei Liu, Mark A. Bradford ,AbdolrezaAtaei (2017)

This study investigated the Composite beams comprising of concrete slabs and steel beams joined by conventional headed stud shearconnectors are commonly used in modern steel-framed building construction. However, because theheaded stud shear connectors are welded onto the top flange of the steel beam and cast into thein situ concrete slab, deconstruction of the composite beam and the reuse of its components at the endof structural life in defence to demolition is virtually impossible, which is at odds with the increasingdemands placed on improving the sustainability of building infrastructure. As an alternative, an innovativesustainable composite beam and slab system is proposed, in which precast geopolymer concrete panelsare attached to the steel beams using high-strength friction-grip bolts instead of cast in situ floors withpre-welded headed stud connectors. The advantages of a low-carbon design, both by the use of geopolymerconcrete elements and system deconstructability, can be achieved in this proposed system. In thispaper, a three-dimensional finite element model is developed to investigate the structural behavior of the proposed sustainable composite beam and slab system. Material non-linearities and the interactionof the structural components are included in the model. The accuracy and reliability of the finite elementformulation developed are validated by comparisons with experimental results. Extensive parametric studies are conducted to elucidate the effects of the change in the concrete panel configuration, the numberand diameter of the bolts, the type and strength of the concrete and the grade of the steel beam on thebehavior of the system. The use of modified rigid plastic analysis is assessed, and a modification is suggestedto predict the flexural strengths of the composite beams and slab system

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Ying Xing ,Qinghua Han , JieXu, Qi Guo , YihongWang (2016)

Elastic concrete (rubber-filled concrete) is employed into the steel concrete composite structures due to its goodductility and crack resistance. Bending test and numerical simulation were conducted to investigate the static behaviour of partial shear connected elastic concrete-steel composite beam with different section size, studsand degrees of shear connection. The results of the tests show that elastic concrete could improve the ductilitybehaviour of stud and composite beam, and reduce the width of concrete cracks efficiently. Larger degree ofshear connection can lengthen the elastic stage and retard the development and spread of slip, but may lead toe decrement of ductility. With the degree of shear connection unchanged, stud with large diameter of 22 mmmay cause 9% lower ultimate bearing capacity, and even worse deformability and ductility of composite beamcompared with the smaller stud. Moreover, the analysis results exhibited a good behaviour and applicability ofthe elastic concrete in the partial shear connected composite beams. With the help of elastic concrete, ductilityof composite beam has been improved effectively so that it is possible to apply large studs into practice.

Jia-Bao Yan , Jun-YanWang , J.Y. Richard Liewd, Xudong Qian d, Zhong-Xian Li(2016) This paper studied the structural behaviors of steel–concrete–steel sandwich composite plates under patch loads.Ten SCS sandwich plates, adopting an ultra-lightweight cement composite (ULCC) and overlapped headed studsas the bonding measures at the steel–concrete interface, were simply supported and subjected to patch loads tillfailure. The investigated parameters included spacing of the connectors, strength of the ULCC core,thickness ofthe steel skin, volume fraction of the fiber, and depth of the cross section. Test results estimated the size of thepunching cone and showed that load-defection behaviors of the SCS sandwich plate contained fivestages.Theinfluences of the different parameters have been discussed and analyzed. Analyticalmodels have been developedto predict the ultimate resistances of the SCS sandwich plateunder patch loads through modifying the code equations.These innovations and modifications included developing models to predict the tensile resistance of theconnectors, incorporating the contribution of the top steel skin on the punching shear resistance, considerationof the tensile resistance of the connectors on the second peak resistance of the structure, and adopting a propercritical perimeter. The validations of the predictions againstthe test results showed that the code provisionsoverestimated ultimate resistances of the SCS sandwich plates and the developed analytical models offeredreasonablygood agreements. Design recommendations were finally given based on these validations and discussions.

SeyedRasoulMirghaderi, NasrinBakhshayeshEghbali, Mohammad Mehdi Ahmadi (2016), Investigated a new moment connection between steel beams and a reinforced concrete column (RCS). Inthis proposed connection, two parallel beams pass from both sides of the column and are welded to the coverplates surrounding the concrete column in the joint area. This detail provides two main advantages comparedwith previous constructions: first, both the beam and column are continuous in the joint area, which providesmore reliable performance, and second, the force transfer occurs in such a manner that the cover plates are loadedin-plane and stress concentration is prevented in the connection components. Bar shear connectors wereinstalled between the steel and concrete inside the cover plates to restrict sliding. The force transfer mechanismsand design procedure are described, and the seismic behavior of the proposed connection is studied in two experimentaltests under cyclic loading. The test results showed that both specimens sustained 8% story driftwith stable hysteretic loops and that the proposed connection is acceptable as a special moment connection. Inaddition, the test results demonstrated that the proposed design relationships were arranged properly suchthat the cover plates were maintained in the elastic phase, only slight cracks appeared in the column, and plastichingeswere formed in the beams in the vicinity of the column. Furthermore, to clarify the behaviour and shear capacityof bar shear connectors embedded in a confined concrete, two push-out specimens were tested undermonotonic loading.

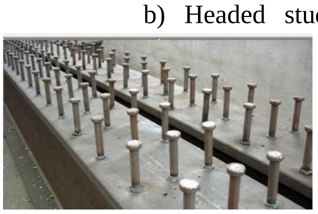
Yu-Bing Leng, Xiao-Bing Song(2016) This paper studies the shear performance of steel–concrete–steel (SCS) sandwich slender beams inter-connectedwith round steel bars and headed studs. Nine beams with shear span/depth ratio from 2.5 to 3.5 were testedunder static loads. Other experimental parameters include the diameter and spacing of the vertical tie bars andstud connectors. All beams failed by vertical shear with the failure patterns differing slightly due to stud arrangementand shear reinforcement ratios. Test results show that the shear resistance after critical cracking is dependenton the strength of vertical reinforcement, steel plate and stud connectors. Based on the observed failuremodes, an analytical expression is derived for the shear resistance after critical cracking. The mechanicalmodel considers the contribution of the vertical reinforcement and the dowel resistance resulting fromthe compositeaction between the steel plate and concrete. The stud spacing value is recommended to maintain a fullcomposite behavior in shear span, and if it is exceeded, the dowel action should be revised accordingly. Accuracyof the proposed method is ascertained by comparing with the test results.

ZhenyuHuang , J.Y. Richard Liew (2016)
This paper investigates the structural behavior of Steel-Concrete-Steel (SCS) sandwich wall which consists oftwo external steel plates infilled with ultra lightweightcementitious composite material. A series of compressiontests consists of a wide range of parameters have been carried out on the SCS sandwich walls of different heightsforming short and slenderwall. The test results showthat the SCS sandwich walls with J-hook connectors exhibitcomparable behaviour in compressive resistance and post-peak unloading behaviour to the ones with the overlappedheaded studs. The interlockingJ-hook connectors play an important role in providing composite actionbetween the steel plates and the cementitious core, and preventing or delaying the local buckling of the externalsteel plates. The test results are compared against the predictions by Eurocode 4 and AISC 360 methods for compositecolumns. It is found that the Eurocode 4 and AISC 360 methods could over-predict the compressive resistanceof sandwich wall subjected to compression. A modified method is then proposed,which takes into accountthe effect of interlocking J-hook connectors in providing lateral restraints to the external steel plates. The predictionsshowa reasonable correlation with the test results. Nonlinear finite element model has been established to predict the load displacementcurves, maximum resistance and failure modes of the sandwichwalls. Both the experimentaland finite element results confirm that the proposed analytical formulae are conservative for designof SCS sandwich composite walls with J-hook connectors.

5.MATERIAL STUDY ON SCS SANDWICH BEAM
SDS-Self Drilling Screw,**S-Stud,VS**-V Shape,**HS**-Headed stud,**JH-**J-Hook,**ASB-**AngleSteelBar,O**HS**-Overlapped HeadedStud**,FGB**-FrictionGripBolt**,BSC**-Barshear connector

a) J-Hook

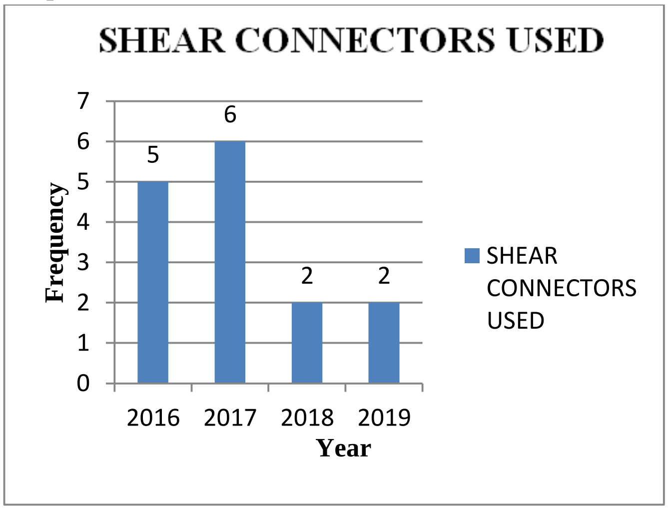
b) Headed stud



Tabulation 1

SL. NO	Y/M	SDS	S	VS	HS	JH	ASB	OHS	FGB	BSC
1	2019	1								
2	2019		1							
3	2018			1						
4	2018		2							
5	2017		3							
6	2017				1					
7	2017					1	1	1		
8	2017				2					
9	2017		4							
10	2017								1	
11	2016		5							
12	2016									1
13	2016				3					
14	2016					2				
15	2016				4					

Graph 1:



Tabulation 2:

SL.NO	YEAR	TYPES OF SHEAR CONNECTORS	DIA OF SHEAR CONNECTORS
1	2019	Self drilling screws fixing the web of S.C.Concrete	Screw = 4.8 mm, Bolt = 6 mm
2	2019	Stud	19 mm
3	2018	V- Shaped , Shear stud bolt	V- Shaped t = 3.75 mm, 2.65mm Stud = 19 mm diameter, 130 mm high
4	2018	Stud connectors	19 mm
5	2017	Stud	Dia = 6 mm, length = 50 mm, spacing = 60 mm

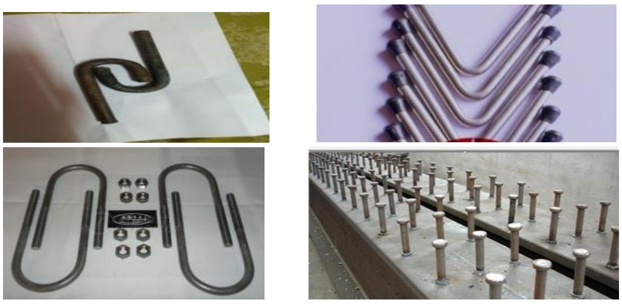
6	2017	Headed stud	Dia = 19 mm
7	2017	Headed stud	Dia = 16 mm, 19 mm
8	2017	J-hook connectors, Angle steel barangle(AST), Angle T-channel, Overlapped headed stud connectors	10 mm
9	2017	Headed stud	Dia = 13 mm
10	2017	Shear stud	10 mm diameter, 75 mm hight, 120 mm spacing
11	2017	Friction grip bolt	Dia = 20 mm
12	2016	Stud shear connector	Dia = 16 mm, 19 mm, 22 mm
13	2016	Bar shear connector	Dimention = 30 mm * 20 mm * 50 mm
14	2016	J-hook	Depth = 125 mm & dia = 13 mm
15	2016	Headed shear stud	Dia = 13 mm ,depth = 75mm , 150 mm

Tabulation 3 :

SL.NO	YEAR	TYPES OF CONCRETE	COMPONENTS AND DIMENSIONS	FLEXURAL STRENGTH (N/mm2)
1	2019	Plain concrete	Beams 150 mm to 300 mm deep Type 1 composite section of 0.8 m and 1.7 m span 100 mm * 50 mm * 1.2 m	465
2	2019	Conventional Concrete	Walls Span = 6705.6 mm, Thick = 762 mm	27.6
3	2018	Conventional Concrete	I secction steel Beam = 250 mm * 73 mm	35
4	2018	Conventional Concrete	Composite beam L = 11400 mm, B = 2850 mm	42
5	2017	Conventional Concrete	Cube wall 150 mm * 150 mm * 300 mm	57.8
6	2017	Self consolidating concrete	Steel tube thickness = 6 mm & 10 mm, column length = 60 mm , cross sectional area = 200 * 200 sq.mm	30
7	2017	Elastic concrete i.e., concrete with addition of tire rubber	Cube wall = 150 mm * 150 mm * 150 mm ; Prism = 100 mm * 100 mm * 300 mm	37.8
8	2017	Light weight cement concrete, ULWC	Length = 1200 mm, width = 495 mm	64
9	2017	Normal concrete	Slab height = 300 mm, thickness=6 mm, length = 2400 mm	31.9
10	2017	Normal concrete	I-Section of steel beam UC 203 mm* 203 mm * 46 mm , Flange thickness 11 mm, Concrete slab 100 mm thick & 450 mm wide	58
11	2017	Geopolymer concrete	Slab = 1000 mm* 150 mm	32
12	2016	Elastic concrete	Section of beam HW 250 mm * 250 mm, slab b= 130 mm	38.97
13	2016	Conventional Concrete	Steel beam and reinforced concrete column height = 3000 mm,span = 4000 mm,breadth =400 mm, depth= 400 mm	38
14	2016	ULCC	SCS shell structures width = 1250 mm, span = 1250 mm & depth = 140 mm	35
15	2016	ULWC	Curved SCS beam	49

6. MATERIAL COLLECTION

ShearConnector:J-Hook, Stud, V-shaped shear connector, Headedstud,Frictiongripbolt.



(a) J-Hook (b)V-Shape (c) U-shape (d) Headed stud

(a) (b) (c) (d) (e) (f)

(a) Stud bolt. (b) Channel Section. (c) Perfobond. (d) Perforated ribs. (e) Bars. (f) Bolt

Steel Plate:

Steel plate act as flexural reinforcement and offer permanent formwork and increase construction efficiency. The steel plates are impermeable and acts as impact and blast resistant membranes.Steel plates are used to fabricate SCS sandwich beam as face plate (top and bottom) of mild steel grade Fe 250.The Young's modulus (Es), Poisson ratio (vs), yields strength (fy) and ultimate strength fu of the steel plates.Mild steel plate of 4mm,6mm were used.

Steel cable:

Steel cable of size 6mm were used.

Concrete core:

Light weiht concrete or Ultra –light weight concrete are mostly used in SCS sandwich beams.

6.TEST CONDUCTED

FLEXURAL TEST: The flexural test measures the force required to bend a composite beam under a four point loading system. The test method is used for reinforced or unreinforced materials. The major difference between four point and three point lading system is the location of the bending moment. The four point bending method allows for uniform distribution between two loading noses.

The flexural strength is given by

$fb= pl/bd^2$(when a>20 cm)

$fb=3pa/bd^2$(when a<20cm)

Where a=the distance between line of fracture and the nearer support measured on the centre line of the tensile side of the specimen

b= width of specimen(mm)

d=failure point depth(mm)

l=supported length(mm)

p=Maximum load(kN)

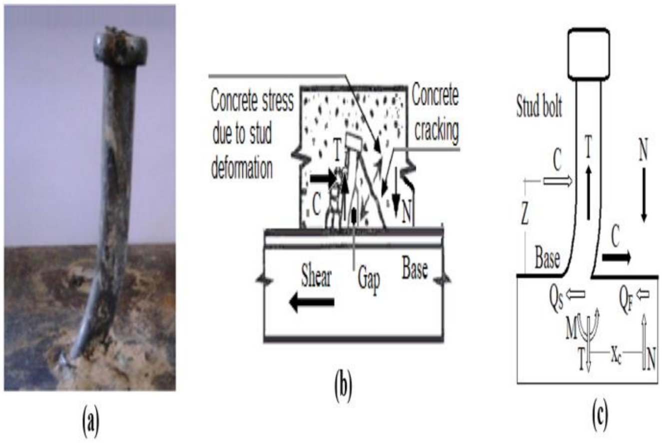
All the specimens were tested under a universal testing machine with load carrying capacity of 1000kN. The composite beams were simply supported over an effective span of 700mm and tested under two point loading system. The deflection at the beam was measured digital.To visually observe the cracks in the concrete core records all data such as load, deflection while testing. The first crack and the first yielding of concrete and steel were closely observed. After testing the concrete core was removed to observe the deformation of the shear connectors.

Figure:Universatestingmachine

PUSH OUT TEST FOR SHEAR CONNECTOR:

To estimate the shear connector's strength for the purpose of designingthe proposed connection, two push-out specimens with plainconcrete and reinforced concrete (RC) were tested under monotonic loading

Figure



(a) Stud bolt after a push-out test, (b) Compressive force on stud bolt, (c) Resistance mechanism.(3)

7. CONCLUSION

Based on the literature review, following conclusions are obtained

1. In previous literature review,the Stud and Headed stud shear connectors were used many times in past 4 years.
2. In this method of sandwich beam with shear connectors are mostly used in the year of 2017
3. Shear connectors diameter ranges from the literature review are 6-20mm.
4. In this method,shear connectors are used to resist the Shear failure and to increase the load carrying capacity.

Finally from this review it is well known that Stud and Headed stud are widely used on SCS composite structure.

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