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AnalyticalStudy ofReinforcedConcretedeck slab bridgewithvarying Span & Thickness Conceptual Review

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Abstract-*Abridge is a building thatallows travelover an additional obstacle without blocking the approach at a lower point. The necessary passage may also be for a pipeline, a canal,a road,a railroad,pedestrians, ora railway. It maybe necessarytocrossariver,road,railway,orvalley.TheT-beam Bridgeisbyfarthemostwidelyusedtypeforspansbetweenten andtwenty-fivemeters.Thestructureis sonamedbecausethe first longitudinal girders are constructed as T-beams that are monolithicallyjoinedtoaportionofthedeckblock.Overthirty meters of simply supported T-beamspanareuncommonbecause theloadingisthentoosevere.Thecurrentstudywascreatedto analyzethe investigation conducted byvarious researchersin thefieldofsafeandcost-effectivebridgedesign.Theresearch project summarizes previous studies and concludes with a listof research gaps and the subject of further investigation.*

***KeyWords*:**Span/DepthRatio,Deckslab,IRCLoading,Staadpro.

1.INTRODUCTION

Over the past few decades, there has been an enormous increase in the volume of traffic on highways due to population growth and rapid urbanisation. Many new highways and flyovers are being built to ensure smooth trafficflow.Theparamedicstudyaidsindeterminingthe economicfactorduringtheplanningandconstructionof the bridge because the study of Bridge Girder material, size, shape, and selection are based on engineering and economic criteria. The current study was created to analyse the investigation conductedbyvariousresearchers inthefieldofsafeandcost-effectivebridgedesign.The research project summarises previous studies and concludeswith a listofresearch gaps and the subject of further investigation.

2. CONTRIBUTION OF RESEARCHERS IN FIELD OF DECK SLAB BRIDGE

This work begins with an overview of the condition assessment of the old bridge and explained reasons for demolishingofthebridge.Brieflypresentedtheflexural analysisoftwo-stage post-tensionedprestressedconcrete girder, which will replace the old (new bridge). ConstructionofI-girderandcompositegirderatthefirst stage and second stage prestressing respectively is explained with figures. Assessment of the load-caring capacity of the one span of the replacement bridge with simplesupportsusingproofloadtestispresentedwhichis mandatory according to Indian standards. Weighted sandbags were wont to load the bridge up to a preset serviceload withimpactissue. Deflections of theI-girders ofthebridgeweremeasuredatselectedlocationson and across the bridge span and compared with computed values.Alinearresponsewasobservedduringloadingand unloading. Considering the load take a look at results, theoreticalestimationandcriteriaasstipulatedincodesof practice,itcanbeinferredthatprestressedconcreteI-girder bridgespanhasadequatecapacitytocarrytheloadsand hence,deemedtohavepassedthetest.**SaibabuSundru(2018)**

Thispaper describes thelook of 4-lane concrete T-beam bridge considering IRC Class-AAtrackedloading with span varied from twenty-five to 40m. After computing manually and STAAD Pro analysissoftware,it is observed that dead load bending moment with increasing span increases almost square of the span. **Neeraj Kumar (2017)**

Inthisstudy,theintegralbridgewithavariousspanlength of40m,50m,60mand70mnon-skewandskewsanglesof 15°, 30°, 45° and 60° were designed and modelled in SAP2000 software. The parameters investigated in this analyticalstudyweretheskewangle,spanlengthandstress reduction methods. The geometric dimensions of the IntegralBridgeandtheloadingusedfollowedAASHTO commonplacespecifications.Staticanalysisanddynamic nonlineartimehistoryanalysiswereperformedtoassess theseismicperformanceoftheintegralbridge.Theanalysis resultsintermsofshearsandbendingstresses,axialforce and deflection were checked by the allowable stress method.Extremestressesthat exceedallowablelimitwere reduced byusingsixdifferentstressreductionmethods. Theproposeofthisstudywastoanalyzethebehaviourof integral, skew angle, and to reduce extreme stress of integral bridge under dynamic loading. In skew angle bridge,crossframememberstressincreasesgreatlyasthe skewbridgetendtorotateduringaseismicevent,which cancauseexcessivetransversemovement.MSE+HLAC methodwasthebeststressreductionmethodforallnon-skew and skew angle bridge. According to the analysis result, integral bridge maximum skew angle can be extended up to 60° and span length up to 60 m can be extended using stress reduction method under extreme seismic loading.**Haymanmyintmaung, (2017**

inThisthesisgivesthebriefideaaboutthe meaning of bridge and its classification, loads to be considered andthe differentmethods to be adopted for the analysisofT-Beamdeckslabbridge(onlydeckSlabwith girders).ThisprojectAnalyzethestraightforwardT-Beam Deck slab. In T-Beam Deck Slab consists of Slab with Longitudinal and Cross Girders. Girders have analyzed with three different Rational Methods (Courbon theory, Guyon-Massenet,HendryJaeger)forfourIRCLoadings (Class-AA,Class-A,Class-B,Class-70R)andthree

Different country Loadings which are AASHTO Loading, BritishStandardLoading,SaudiArabiaLoading.Also,this projectComparetheAlltheLoadingsandAlltheMethods which are mentioned above, and the same bridge is analyzedasathree-dimensionalstructure usingsoftware STAADProV8i.AnalysisofgirdersintheBridgemeans CalculationofMomentsandShearforcesinducedinthe longitudinal and cross girders at different positions for above-mentioned loadings. Also analyzed the Moments inducedintheSlabduetoIRCLoadingsOnly.Asimple example problem could be taken from the Textbook (DesignofBridgesbyN.KrishnaRaju)forthisProjectand alsotakensomeofthecurvesandGraphs.**Tangudupalli Mahesh Kumar, (2017)**

SanjayTiwari(2017) Cellularsteelsection composite with concrete the deck is one in every of the foremostappropriatesuperstructuresinresistingtorsional and warp effects elicited by route loading. This type of structure has inherently created new style issues for engineers inestimatingits load distributiononcesubjected tomovingvehicles.IndianCodesofobservedoesn'toffer anyspecificpointersfortheplanningofstraightcomposite concretedeck–steelmulti-cellbridges.Tomeetthesensible needs arising throughout the planning method, a simple designmethodisneededforstraightcompositemulti-cell bridgesinthe form ofloaddistributionfactorsformoment and shear. This work presents load distribution characteristicsofstraightcompositemulti-cellboxbeam bridges underneath IRC trains of masses.

Yogita Gupta (2017) The shallow foundation is generally provided on non-erodible strata or where scour depthisless. It is conjointlydesirablefor low perennialfloworstandingwatercondition.Inthepresent case study, theshallow foundation is adopted for box type bridge. The total length of the bridge is 132.98 m, consisting of eight units of RCC box. Each unit is composedofthreecellboxes.Thebottomslabofthebox unit is acted as raft foundation, founded 500 mm below ground level. River bed protection work is provided on boththeupstreamanddownstreamsidealongthewhole lengthofthebridge asitisfoundedabovescourlevel.The bridgecollapsedduringthemonsoonjustaftertwoyears of service. The present paper explainsthecause offailure. This study on the failure of the bridge illustrates the importanceof bridge reviewbeforeandwhenthemonsoon amount and therefore the importance of timely maintenance. Standard specifications of Indian Road Congress for the stream bed protection work also are enclosed.

Tanmay Gupta (2017) Usually, the design moments in the simply supported bridges are obtained becausethetotalofmomentsbecauseofdeadmassesand superloadwhereverthesuperloadmomentsarecalculated victimization the rolling load conception neglecting the result of dead loads. For the merely supported bridges, uniformly distributed dead load produces maximum momentatmidspanwhiletheabsolutemaximumbending moment due to multi-axle vehicles occur under a wheel whichusuallydoesnotlieatmid-span.Sincethelocation oftheabsolutemaximumbendingmomentduetothe multi-axlevehicledoesnotcoincidewiththelocationof themaximummomentdue to deadloadsoccurringatmid-span,thedesignmomentmaynotbeobtainedbysimply superimposing the effect of dead load and live load. Moreover,justincaseofClass-AandClass-70Rwheeled conveyancelivemasses,whichconsistsofseveralaxels, the number of axels to be considered over the bridge of given span and their location is tedious to find out and needsseveraltrials.Theaimofthisstudyistosearchout thequantityof wheelsfor Class-AandClass-70R wheeled vehiclesandtheirpreciselocationtoprovideabsolutemost momentinthebridgeconsideringtheresultofdeadmasses andimpactissue.Finally,soastomodifythedesigners,the planning moments because of Class-70R wheeled and Class-Aloadingare conferredin tabulartype forthespans from ten to 50 m.

PragyaSoni(2017) Inthispaper studiedDue topopulationgrowthandrapidurbanization,therehasbeen anenormousgrowthintrafficvolumeonhighwaysover the last few decades. In order to ensure smooth flow of traffic, numerous new highways and flyovers are being constructed.Theuseofbox-girdershasproventobeavery efficient structural solution for highway bridges and flyoversduetoitshightensionalrigidity,serviceability, economy,aesthetics andthe ability toefficientlydistribute the eccentric vehicular live load among the webs of the box-girder. For the multi-lane bridges, multi-spine/cell box-girdersaremostcommonlyadoptedinordertolimit the local deformations in the top slab of the box. Many studiesareavailableonthesuitabilityofboxgirderbridges for various spans and effect of stresses for skewed box girderbridge.Thecurvilinearnatureofboxgirderbridges alongwiththeircomplexdeformationpatternsandstress fields have led designers to adopt approximate and conservativemethodsfortheiranalysesanddesign.Recent literature on straight and falcate beam bridges has restrained analytical formulations to raised perceive the behaviour of those advanced structural systems. It was foundthatresearchershaveusedthefiniteelementmethod fortheanalysisofboxgirderbridge.However,notmany studiesareavailableforthedesignoftheboxgirderbridge. Hence,thisstudyemphasizedonthedesignandanalysisof boxgirderstructure.Theliteraturealsoindicatesthatthe variousresearchershaveusedANSYS,MIDASandStadd-Pro for the analysis of Pre-stressed Concrete Structures using FEM.

Junichiro Niwa(2016) An experimental study of the interface shear transfer between otherwise aged concrete (old and new deck slabs) has been performed.Therecentandnewdeckslabselementswere crossed by steel bars and subjected to the external prestressing force. The tests were applied to be representativeofaprojectedtechniqueusedforwidening prestressed concrete (PC) main road decks. The experimental program comprised 9 specimens checked belowdouble-sheartestbytakingtheinitialprestressing levels, connection methods between steel bars, reinforcementmagnituderelationandsurfaceroughnessas parameters. The experimental results indicated that the failurebehaviouroftheinterfacewasgreatlyaffectedby the initial prestressing level, reinforcement ratio and surfaceroughnessoftheinterface.Finally,acomparisonof

theexperimentalshearstrengthwiththosegivenbyJSCE customarySpecification,AASHTOandfibModelCode 2010 showed a conservative result for low and high prestressing levels, low reinforcement ratio and smooth surface.

Job Thomas S. Ramadass(2016)studied FibreReinforcedPolymer(FRP)barsarebeingwidelyuseda s internal reinforcement in structural elements in the last decade.ThecorrosionresistanceofFRPbarsqualifiesits use insevereandmarine exposureconditionsinstructures. Atotalofeightconcretebeamslongitudinallyreinforced withFRPbarswerecastandtestedovertheshearspanto depthratioof0.5and1.75.Theshearstrengthtestdataof 188beamspublishedinvariousworksofliteraturewere also used. The model originally planned by Indian customary Code of follow for the prediction of shear strength of concrete beams strengthened with steel bars IS:456 (Plain and concrete, code of practice, fourth revision. Bureau of Indian Standards, New Delhi, 2000) is considered and a modification to account for the influence oftheFRPbarsisproposedbasedonregressionanalysis. Out of the 196-test data, 110 test data is used for the regression analysis and 86 test data is used for the validationofthemodel.Inaddition,theshearstrengthof 86testdataaccountedforthevalidationisassessedusing eleven models proposed by various researchers. The planned model accounts for compressive strength of concrete (fck), modulus of elasticity of FRP rebar (Ef), longitudinalreinforcementratio(qf),shearspantodepth ratio(a/d) andsize effect of beams. Thepredictedshear strength of beams exploitation the planned model and eleven models planned by alternative researchers is compared with the corresponding experimental results. The mean of foretoldshearstrength tothe experimental shearstrengthfortheeighty-sixbeamsaccountedforthe validation of the planned model is found to be zero.93. The result of the statistical analysis indicates that the prediction based on the proposed model corroborates with the corresponding experimental data**.**

Kearthi.S(2016) Inthispaperstudied structures are subjected to two types of load: static and dynamic.However,mostcivilengineeringstructuresare designed with the assumption that all applied loads are static. The effect of the dynamic load is not considered because the structure is rarely subjected to dynamic loads; moreso,itsconsiderationinanalysismakesthesolution more complicated and time-consuming. This feature of neglectingthe dynamic forces may sometimes becomethe causes of the disaster, particularly in the case of an earthquake. Therefore, it is proposed to do “dynamic analysis of bridge deck” for the various span of the bridge by varyingnumber oflongitudinal girders. The detailed studyiscarried out for “T-Beam Bridge”,for various span 16m, 20m, 24m and 28m under IRC class AA loading condition**.**

SandeshUpadhyay K (2016)T-beam bridges are one among theforemost usually used forms of bridge and thence it's necessary to perpetually study, updateanalysistechniquesanddesignmethodology. Structurally they are simple to construct and maintain. Hence,they'remostwell-likedoveralternativeformsof bridges once it involves providing property at intervals shortdistances.Theaimofourstudywastoworkoutthe variation and quality of 2 completely different configurations of those bridges,namelyordinarydeckslab supported on girders and T- beam configuration of the deckslab.Inthisstudy,wehaveconsideredspanlengths of 20m, 24m and 28m. The deck block has been conventionally analyzed for IRC category AA loading victimization Courbon’s technique. This study also considersallothercomponentsofaT-beambridgesuch as cantilever slab, girders and cross beams. A complete FEManalysisofT-beambridgewithstandarddeckblock supported on girders was performed analysis was valid conventionally exploitation Courbon’s technique analysis for both the configurations of T- beam bridges were extensively studied based on results of maximum Shear Force, maximum Bending moments and maximum deflection values. From the study, the T-beam configuration of deck slab proves to be effective than ordinary deck slab supported on girders

Y.YaduPriya(2016) Theanalysisiscarried outusingIRCcodeprovisions.T-beambridgedecksare oneofthemajor typesofcast in-situconcretedeckswhich consistofaconcreteslabintegralwithgirders.The problemincontinuummechanicsisapproximatedbyFEM (finiteelementmethod)inSTAADPro,whichisthe generalmethodofstructuralanalysis.Inthisstudy,a single span two-lane t-beam bridge is analyzed byvarying thespanof25m,30m,35m,40mwherethewidthiskept constant.ThebridgemodelsaresubjectedtotheIRC categoryAA andIRC 70Rtracked loading systemso as to getmostbendingmomentandshearforce.Fromthe analysis,itisobservedthatwiththeincreaseinthespan, shear force and bendingmoment inthe girder increases. It isalsoobservedthattheresultsofbendingmomentsand shear forces obtained from both courbon’s method and finite element method have no significant variation.

PrafulNK(2015) Inthispaperstudiedbridgeisastructure providing passage over an obstacle without closing the way beneath. The required passage could also be for a road,arailway,pedestrians,acanalorapipeline.T-beam bridge decks areoneamongthe principal formsof cast-in-placeconcretedecks.T-beambridgedeckscarrywithita concreteslabintegralwithgirders.Thefiniteelement techniquecouldbeageneraltechniqueofstructural Analysisduringwhichtheanswerofahaulintime mechanicsisapproximatedbytheanalysisofan assemblageoffinitepartsthatareinterconnectedatafinite varietyofnodalpointsandrepresentthesolutiondomain ofthematter.AsimplespanT-beambridgewasanalyzed by I.R.C. loadings as a one-dimensional structure using rationalmethods.ThesameT-beambridgeisanalyzedas a three-dimensional structure mistreatment finite componentplateforthedeckslabandbeampartsforthe most beam using software package STAAD ProV8i, three differentspansof16m,20mand24mwasanalyzed.Both FEMand1DmodelswhereversubjectedtoI.R.C.

Loadingstoproduceamaximumbendingmoment,Shear force and similardeflectioninthestructurewereanalyzed. Theresultsobtainedfromthefinitecomponentmodelare lesserthantheresultsobtainedfromtheone-dimensional analysis, which suggests that the results obtained from manual calculations subjected to IRC loadings are conservative.

Kalpana Mohan (2015) In this paper studiedBridgegirdermaterial,size,shapeandselection are based on engineering and economic criteria. Steel concrete composite construction has gained wide acceptanceasanalternativetopuresteelandpureconcrete construction,thereis noneed forformworkbecausethe steel beam is able to sustain the self-weight of steel and concrete with few temporary props. In this paper, we present analysis and results of steel and steel reinforce bridge girders, based on STAAD Pro analysis and manual analysis.8 combos of bridge girders are taken and compared.

VikasGandhe(2014) Bridgesarehighly investment structures and important landmarks in any country besides being vital links in the transportation system. Strength, safety and economy are the three key features that cannot be neglected before the finalization of types ofbridges.While deciding thetypes ofbridge,spans and other parameters are to be studied carefullytomeet outtheneedofsuitabilitytositeconditions.Thescopeof this paper is to confine to the design aspect related to variable parameters. Depth of web, the thickness of the web, the width of flange and span of bridges are the variableparametersconsideredduringthedesignof plate Girder Bridge.Thegraphicalrepresentationisshowingthe relations between different parameterstoconcludeforcost effectiveness with respect to spans. Broad gauge mainline loading is adapted to carry out design calculations. Bendingandshear stresses are plotted against thespans to checkthestabilityofthestructure.Theresultssummarized in this paper will be a guideline to field and budding engineers

IbrahimS.I.Harba(2011) Inthispaper studied T-beam bridge is a common choice among the designersforsmallandmediumspanbridges.Inorderto catertolargerspeedand alotofsafetyofcontemporary traffic, the modern highwaysare tobe straight as faras possible. This requirement, along with other requirements forfixingalignmentofthebridges,ismainlyresponsible for theprovisionofanincreasingnumber ofskewbridges. Thepresenceofskewinanexceedinglybridgemakesthe analysis and style of bridge decks complex. For the T-beambridges withlittleskewangle,it's oft thoughtofsafe to ignore the angle of skew and analyze the bridge as a right bridge with a span equal to the skew span. However, T-beam bridges with an oversized angleof skew will have a substantial impact on the behaviour of the bridge particularlywithintheshorttomediumvaryofspans.In this paper, an analytical study using three-dimensional finiteelementmethodswasperformedtoinvestigatethe effect of skew angle on the behaviour of simply supported reinforcedconcreteT-beambridgedecks.Theparameters investigated during this analytical study were the span lengths and skew angle. The finite part analysis (FEA) resultsfor inclinedbridgeswerecomparedtothereference straightbridges(nonskewed).Thegeometricdimensions oftheT-beambridgedecksandalsotheloadingusedare incompliancewithAASHTOcustomaryspecifications. The FEA results and comparison of the skewed bridge witha straightbridge indicatethatmax.Liveloadbending moments and deflections decreases in T- beams for inclinedbridges,whilemax.shear,torsionandsupports reactionsincreasesinsomeT-beamsforskewedbridges forallconsideredspanlengths(12,16,20and24m).This study disagreement with the AASHTO standard specificationsaswell astheLRFDinrecommendingthat bridges with a skew angle less than or equal 20° be designedasstraight(non-skewed)bridgesadditionallyit suggested that engineers are higher to perform three-dimensional finitepart analysisforinclinedT-beambridge decks.

V Raju, DevdasMenon (2010) The thought of formed bridge beam is currently being more andmoreadoptedinurbanrailwaysystemrailcomesand for replacement recent bridges wherever there's a constraint on vertical clearance. These bridge decks are ordinarily designed in apply exploitation simplified strategiesthatassumebeamactionofthewebswithinthe longitudinal direction and similar flexural action of the deck slab in the transverse direction. However, such assumptionscanleadtoerrors.Thispapertriestoassess the extent of error within the simplified analysis, by examination the results with a lot of rigorous three-dimensional finitepart analysis(3DFEA).Atypicalmodel railwaybridgebeamhasbeentakenasacasestudy.The results of the 3DFEA, in terms of load-deflection plots, have been validated by field testing.

O'Brien,Eugene.(1998) Forblockbridgedecks with wide thwart wise cantilevers, the plane grillage associatelogyisshowntobeaninaccuratemethodology oflinearelasticanalysisbecauseofvariationswithinthe verticalpositionoftheneutralaxis.Theupstandgrillage analogyisalsoshowntogiveinaccurateresults,thistime duetoinappropriatemodellingofin-planedistortions.A new methodology, known as upstand finite element analysis, is proposed which is sufficiently simple to be usedonaneverydaybasisinthedesignoffice.Themethod is shown to give much better agreement than the others when compared with an elaborate three-dimensional solid finiteelementmodel.Single-andtwo-spanbridgedecks withsolidandvoidedsectionsarethought-aboutforeach longitudinal and thwart wise bending stresses.

BudiRyantoWidjaja(1997) Inthis thesisstudiedcold-formedsteeldecksareemployedinjust about each steel-framed structure for composite block systems, efforts to develop more efficient composite floor systemscontinues.Efficientcompositefloorsystemswill be obtained by optimally utilizing the materials, which includesthe possibility of developinglongspancomposite slabsystems.Forthispurpose,newdeckprofilesthatcan havealongerspanandbetter interactionwiththe concrete

slab are investigated. Two new mechanical basedmethods forpredictingcompositeslabstrengthandbehaviourare introduced.Theyarereferredtoastheiterativeanddirect methods. These methods, which accuratelyaccountforthe contribution of parameters affecting the composite action, areusedtopredictthestrengthandbehaviourofcomposite slabs. Application of the methods in the analytical and experimentalstudyofstrengthandbehaviourofcomposite slabs,ingeneral,revealsthatmoreaccuratepredictionsare obtained by these methods compared to those of a modified version of the Steel Deck Institute method (SDI-M).Anonlinearfiniteelementmodelisalsodevelopedto provide an additional reference. These methods,whichare supported by elemental tests of shear bond and end anchorages, offer an alternative solution to performing many full-scale tests as required for the traditional m-k method. Results from twenty-seven composite block tests are compared with the analytical ways. Four long span compositeslabspecimensof20ftspanlength,usingtwo different types of deck profiles, were built and tested experimentally.Withoutsignificantlyincreasingtheslab depth and weight compared to those of composite slabs with the typical span, it was found that these long span slabs showed goodperformance under the load tests. Some problems with the vibration behaviour were encountered, which are thought to be due to the relativelythinlayerofconcretecoverabovethedeck rib.Furtherstudyontheuseofdeeperconcretecover to improve the vibrational behaviour is suggested.

3. GAP IN RESEARCH REVIEW AND OBJECTIVE OF NEW RESEARCH

Basedonthesurveyofavailableliteraturefollowinggaps in the research are identifying.

1. Thereisverylimitedresearchwhichfocuseson varyingSpan/DepthratioofRCdeckslabbridge with different span.
2. There is almost Nil research available for span/depth ratio withconsideringspan/widthratio of deck slab bridge.

Basedonabove-mentionedgapsfollowingtheobjectives of the research are being investigated

1. ToevaluatetheperformanceoftheRCdeckslab with varying depth/span ratio.
2. To compare stresses on girders and piers of the bridge with varying the thickness of the deck slab to optimize the performance of the bridge with safe and economic aspects.

4.CONCLUSION

From the research we understandabout thecontributionof different research in the field of the deck slab structure system, a gap in theresearch and objective of the research tobeconducted.Thesecontributionshelptovisualizethe problemfacedbyRCdecksabfromanewperspective.By evaluating the performance of deck slab bridge with differentthicknessesitsenhancedeconomicaspectmay be achieved, whichshall lead to thedirection ofthedesignof safe stronger and more economical bridge.

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