Confidential Reporting Of Structural Failures And Lessons Learnt
NEWSLETTER
A PUBLICATION OF INDIAN ASSOCIATION OF STRUCTURAL ENGINEERS
VOLUME : 5 ISSUE : 1 JANUARY - MARCH, 2026

FROM THE DESK OF THE PRESIDENT

This is the 15TH issue of CROSFALL newsletter. This newsletter is gaining prominence amongst the civil engineering fraternity. The CROSFALL newsletter is proving to be extremely useful for today's-built environment. As construction scales up and infrastructure failures increase—often driven by poor detailing, compressed timelines, or lack of site supervision—the newsletter offers a safe, confidential platform to share failure case studies and near-misses without fear of liability or exposing identities.

Through this newsletter, IAStructE has shown how valuable this type of no-blame reporting of concerns can be in identifying potential causes of failure before they happen. This is one way of ensuring that the risk of failure is mitigated.

While CROSFALL is making its impact slowly, the failures in India somehow are being witnessed more frequently than ever before. Several high-profile structural failures have occurred over the past 15 days, spanning both residential buildings and massive public infrastructure projects. These incidents have prompted widespread public concern and raised critical questions about construction quality and civic oversight. Some of the major catastrophic failures in India which occurred in last 15 days are :

- **Fire at a Malviya Nagar (New Delhi) B&B (June 3, 2026) :** 23 lives lost. Delhi appears to be the fire hazard capital of India where statistics show that 95 deaths were reported in 2019-20, followed by 41 deaths in 2020-21, 55 in 2021-22, 95 in 2022-23, 77 in 2023-24, 90 in 2024-25, and 65 deaths in 2025-26 up to March 21.
- **Failure of Gantry Crane at Faridabad (June 4, 2026) :** Caused during a thunderstorm : 3 casualties and 1 worker lost his arm.
- **ROB Failure at Buxar, Bihar (June, 2026) :** A newly constructed ₹26.4 crore ROB at the Itarhi railway crossing suffered a massive structural failure and sank by more than a foot just 96 hours after its grand inauguration, forcing an immediate closure.
- **Vikramshila Bridge, Bhagalpur, Bihar (May 4, 2026) :** A 34 meter suspended span of the 4.6 km long Vikramshila Setu collapsed into the Ganga River, resulting in major traffic diversions and sparking immediate administrative investigations.
- **Anand, Gujarat (May 30, 2026) :** A precast girder toppled in an under-construction railway overbridge near Adas village during erection.
- **Collapse of 5-Storey Building in Saket, South Delhi (May 30, 2026) :** A crowded 5-story commercial building in the Saidulajab area suffered a sudden structural collapse. It housed coaching centres and resulted in the tragic deaths of six students and staff
- **Two 4-storeyed building collapsed at Karawal Nagar, Delhi (June 3, 2026) :** Two separate four-story residential structures collapsed within days of each other. One of these incidents was triggered by reckless, unsupervised drain excavation work next door, though timely evacuations prevented casualties.

The above list is incomplete and do not give the true scale of crisis, which is even worst. The true scale of disasters—whether looking at natural hazards like floods, cyclones, and earthquakes or man-made emergencies—extends far beyond. Vulnerabilities are deeply compounded by unplanned urbanization, environmental degradation, and climate change. This situation makes CROSFALL Newsletters a powerful tool and an essential read for many stakeholders in the industry, academia, and government.

I wish to close my message by once again requesting all readers of this newsletter to spread this newsletter widely amongst your peers and encourage all for reporting structural safety concerns, even if they seem minor, to prevent future failures. Reports can be submitted confidentially, and the process focuses on learning, not blame. Information shared helps improve industry safety standards, making it crucial for professionals to contribute their experiences.

Happy Reading

— Alok Bhowmick

MESSAGE FROM CHIEF EDITOR

Welcome to another issue of CROSFALL, a platform dedicated to sharing lessons from structural failures, construction challenges, and near-miss events with the sole objective of improving safety and engineering practice.

The three reports featured in this issue reinforce an important truth: many structural problems arise not because engineering principles are unknown, but because well-established fundamentals are overlooked during planning, detailing, construction, or decision-making.

The first report describes the challenges encountered during the sinking of large-diameter well foundations for a railway bridge. The case highlights the consequences of deviating from established design principles, the importance of understanding scour and foundation behaviour, and the need to carefully evaluate expert recommendations before adopting alternate solutions.

The second report presents a case of distress in flyover pier caps caused primarily by inadequate reinforcement detailing. Although the structure satisfied design calculations, deficiencies in force-transfer mechanisms and reinforcement continuity resulted in cracking during construction. The case serves as a powerful reminder that structural safety depends as much on detailing as on analysis.

The third report discusses the failure of false steining during the sinking of a well foundation. The incident demonstrates how seemingly minor detailing and workmanship deficiencies can lead to significant construction-stage problems. It also illustrates the importance of understanding temporary works, which often receive less attention than permanent structures despite their critical role in construction safety.

Collectively, these reports emphasize the need for greater attention to constructability, detailing, quality control, and independent technical review. They remind us that successful engineering requires a balanced integration of sound design, practical construction knowledge, and professional diligence.

I encourage readers to reflect on these lessons, share their experiences, and contribute to future editions of *CROSFALL*. Through collective learning and open discussion, we can continue strengthening the culture of structural safety within our profession.

— Umesh K. Rajeshirke
Chief Editor, CROSFALL

Editorial Board Members

Chief Editor

Mr. Umesh K. Rajeshirke, GC Member, IAStructE & MD, Spectrum Techno Consultants Pvt. Ltd.

Member

Mr. Alok Bhowmick, President, IAStructE & MD, B&S Engg. Consultants Pvt. Ltd.

Prof. R. Pradeep Kumar, Immediate Past President, IAStructE & Director, CSIR-CBRI, Roorkee

Mr. Manoj Mittal, Past President IAStructE & Civil / Structural Engineering Consultant, Shelter Consulting Engineers

Prof. Mahesh Tandon, Past President IAStructE & Chairman, Tandon Consultants Pvt. Ltd.

Mr. Rajiv Ahuja, GC Member, IAStructE & Independent Consultant (Highways & Bridges)

Mr. V. N. Heggade, Vice President (West), IAStructE & Design & Construction Consultant, DECon Complete Solutions

Dr. Harshavardhan Subbarao, GC Member, IAStructE, Chairman & MD, Construma Consultancy Pvt. Ltd.

Dr. Vandana Bhatt, Techno-Legal Consultant at Pro-Care Project Administrators & Management Advisors

Mr. Partha Pratim Banerjee, Honorary Treasurer, IAStructE & Technical Director, Ayesa India Pvt Ltd.

Mr. V. L Deshpande, Fellow IIBE, Advisor, Metalmeccanica Bridge group

Contents

Report No. CF-46 : Design & Construction Challenges Faced in well Foundation of a Railway Bridge & Remediation **03**

Report No. CF-47 : Need for Giving Adequate Attention to Detailing **09**

Report No. CF-48 : Failure of False Steining of Well Foundation during sinking Process **16**

About CROSFALL Newsletter **22**

REPORT No. CF-46

Design & Construction Challenges Faced in well Foundation of a Railway Bridge & Remediation

1. Introduction

The technical challenges faced in design and construction of some of the well foundations of a major river bridge in the western region of India is reported here. 4 out of 14 pier wells in this bridge got stuck at various levels above the design founding level and the contractor's team were finding it difficult to sink the well further down to the approved founding level. The affected wells, which had encountered highly weathered rock at the well curb level, due to which well was not going further down, were re-engineered and foundation redesigned as a solution to the problem faced.

2. Salient Details of the Project

The bridge consisted super structure supporting two rail tracks with higher clearances for double stack container traffic. Span arrangement of this bridge is 15 x 48.50m. The superstructure provided in open web through type, in steel truss (OWG). Large diameter well foundation is provided in this bridge to transfer load from deck to earth below. The substructure-pier provided is wall type, in RCC. Photo-1 shows the drone view of the affected foundations (namely P6, P7, P8 and P9). Fig.1 below shows the transverse elevation of superstructure, Pier and well foundation. Some of the piers are in the land zone where the well foundation dimensions are different.

Photo-1 : View of Foundations affected due to presence of hard strata

3. The Problem Encountered at Site

Contractor was finding difficulties in sinking of some of the well foundations in the main river zone (i.e. P6 to P9). These foundations were passing through predominantly soft disintegrated rock/soft rock/ conglomerate. As per the Good For Construction drawings, these wells were to be sunk 9m below the maximum scour level, but the cutting edge of these wells were ranging from 0.44m to 5.44m below the maximum scour level. As a solution to the problem, contractor claimed that the strata in this zone is in-erodible and hence these foundations can be redesigned as 'open' foundation, with minimum founding depth of 2.5m below scour level. In case the strata is erodible (as was originally considered in design), the foundation has to be taken down and embedded in the substrata for a depth of at least 1/3rd the depth of scour, which works out to more than 9.0m below the scour level. Photo 2 shows view of the dredge hole where attempt is being made to cut through hard strata. Photo 3 shows the dewatering arrangement in the well to ensure dry condition at cutting edge level, to enable workers to go down and facilitate sinking operation.

The matter was referred to an expert committee by the Owner Client. Findings of the Committee is given below in Section 4 below.

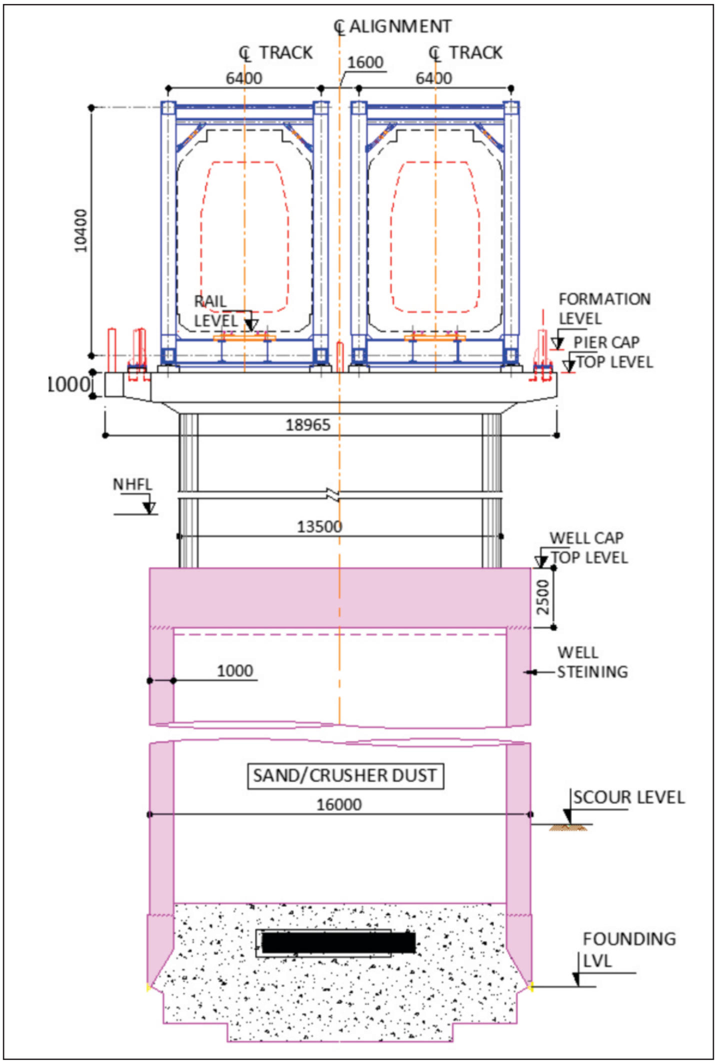


Fig. 1 : Typical Cross Section showing Pier and Well Foundation Dimensions

Fig. 2 : View of the dredge hole for well P7 where attempt is being made to cut thru' rock. Pumping-out of water is simultaneously done to ensure dry condition for ease of working

Fig. 3 : View of the Well from top showing arrangement of pumping to dewater

4. Findings of the Expert Committee

The expert committee, after review of design, construction site, observed the following:

a) There is no scientific basis to support the contention of the contractor that "the strata encountered at around the scour level is non-scourable. Since the BIS, IRC and IRS codes are silent in respect of erodibility and scour in case of disintegrated/soft rock, it was suggested that international code/manual/guidelines etc. may be referred for the estimation of erodibility/scour depth in such type of rock. There are FHWA guidelines available in this regard, which may be referred to by the Contractor.

b) Provided steining thickness of 1.0m for 16m diameter well foundation appears too less and not justifiable from following considerations:

   i. As per Clause 1.2 (b) of the IRS Manual for Well Foundation, the steining thickness should be sufficient to enable sinking without excessive kentledge and provide adequate strength against forces acting on the steining, both during sinking and service. This clause is violated.

   ii. Clause 708.2.3.1 of IRC:78 recommends a minimum thickness for well steining, by using a simplified formula ($t_{min} = K.d.\sqrt{l}$, where K=0.03x1.1, d=16m and l=19.2m) works out to 2.31m, as against provided thickness of 1.0m.

c) Contractor's design assumes 50% buoyancy for stability check and base pressure check of the foundation. The strata visible at the scour level is found to be highly permeable, where sand blows also have reportedly occurred. Design check of well foundation in such strata should have been based on 100% buoyancy.

d) As per Clause 708.2.3.2 (c) of IRC:78, higher grade of concrete, higher reinforcement, use of steel plates to line the inside of kerb, in the lower portion etc., is recommended in situation where the well is likely to rest in rock where blasting may be involved in the process of sinking. These provisions of the code appear to have been ignored in the detailed design. The nature of sub-strata encountered in this project demanded that these provisions should have been incorporated in the original design.

e) 2.5m thick well cap with dredge hole diameter of 14m, supporting wall type pier is supported all around by 1m thick steining. It is feared that mismatch in the relative stiffness between well cap and steining may lead to rotation at well cap ends resulting in circumferential cracks in steining.

In light of the above, the expert committee did not approve of any reduction in the founding level from whatever has been approved by Competent Authority. The Committee noted that it is possible to achieve the desired founding level in these piers also, as has been achieved in other Pier foundations.

5. Suggestions by The Expert Committee

a) Safety of well foundations shall be revisited by the Competent Authority by establishing the appropriate scour level following international codes / guidelines / practice in absence of any provision in IRC/IRS codes. One such reference is Hydraulic Engineering Circular No. 18, Publication No. FHWA-HIF-12-003, April 2012, which may be followed.

b) Permanent instrumentation of the various sub-structure components may be implemented to monitor and validate the design assumptions.

c) The design of well-cap may be revisited in light of observations of the committee. The well cap may be modelled properly in 3 dimensions and FEM analysis performed to assess the behaviour including the long-term impact of dynamic loading. For the foundations where well cap is not yet casted, it is recommended to provide reinforcement as per the revised design. In any case, additional reinforcement in top 2.5 m of well which should be provided, which is to be synchronized with the other reinforcement of Well cap.

6. Final Solution Adopted by Owner Client

Despite the recommendations of expert committee to further sink the well to the approved founding level, the Owner Client and Contractor decided not to continue further sinking of the well foundation. The foundation was completely re-designed and the strata at which cutting edge is placed, is considered as non-erodible.

7. Problems Faced after Construction & Remediation

During the construction stage itself, vertical cracks appeared in steining just below the well cap bottom, which was anticipated by the expert committee when the committee expressed concern about load transfer mechanism from a thick well cap to steining of 1.0m thickness. The foundation had to be rehabilitated. The foundation was converted from 'well' to 'open' by converting the well as solid reinforced concrete pillar. For this purpose, holes were drilled through the well cap, all soils removed from inside the well, well emptied and continuously dewatered, provided peripheral reinforcement and concreted upto 10 to 15 cm below the top. The leftover 10 to 15 cm was grouted under pressure grouting.

Opinion of Expert Panel

The Report brings out many errors in the basic design and construction process of an RCC well foundation, especially the sinking of the well, which was not taken down to designed foundation level. The contractor had refused to comply with the recommendations of an Expert Committee, which was constituted to look into this problem.

The Contractors did not refer to relevant FHWA Guidelines, nor did he follow the requirements of steining thickness laid down in IRC:78. In fact, the contractor has provided less than half the steining thickness of what needs to be provided as per IRC:78. It is obvious that such a reduced thickness cannot generate the required sinking effort and consequently the well could not reach its design founding depth and was founded at a substantially reduced depth. Also, the well cap of 2.5 m depth on a 1.0m thick steining causes a huge change in relative stiffness at the junction, which later led to vertical cracking in the steining near well cap.

The ingenious remedial measures of converting the well foundation to a solid massive reinforced concrete foundation was probably a very expensive and time consuming affair. It remains to be seen how this 'open' foundation and the strata on which it is founded performs under dynamic train loads which are amongst the heaviest class of train loading.

This project provides several important lessons for the planning, design, and construction of well foundations in difficult geological conditions. At the design stage, the characteristics of weathered and soft rock formations must be thoroughly investigated to reduce uncertainty and ensure that the foundation system is appropriate for the site conditions. Large-diameter wells founded in rock require special design considerations, and established recommendations regarding minimum steining thickness should not be overlooked. During construction, potential difficulties in well sinking should be identified through detailed constructability reviews, and suitable provisions for penetrating hard or irregular rock strata should be incorporated in advance. If a foundation redesign becomes necessary, any proposal to change an embedded well foundation into a rock-founded or open foundation should be supported by comprehensive geotechnical, hydraulic, and structural studies. Construction challenges alone should not be considered sufficient justification for reducing the approved founding depth, as such decisions may adversely affect the long-term safety and performance of the structure.

It is not clear why the recommendations of the Expert Committee were not followed, especially since the Committee had raised important concerns about foundation safety, scour effects, steining thickness, and load transfer from the well cap to the foundation. The appearance of cracks during construction and the subsequent need for rehabilitation and strengthening indicate that these concerns deserved serious consideration. The repair works resulted in additional time and cost to the project and required major engineering interventions after construction had already progressed.

The case demonstrates the importance of maintaining a proper balance between construction practicality and sound engineering requirements.

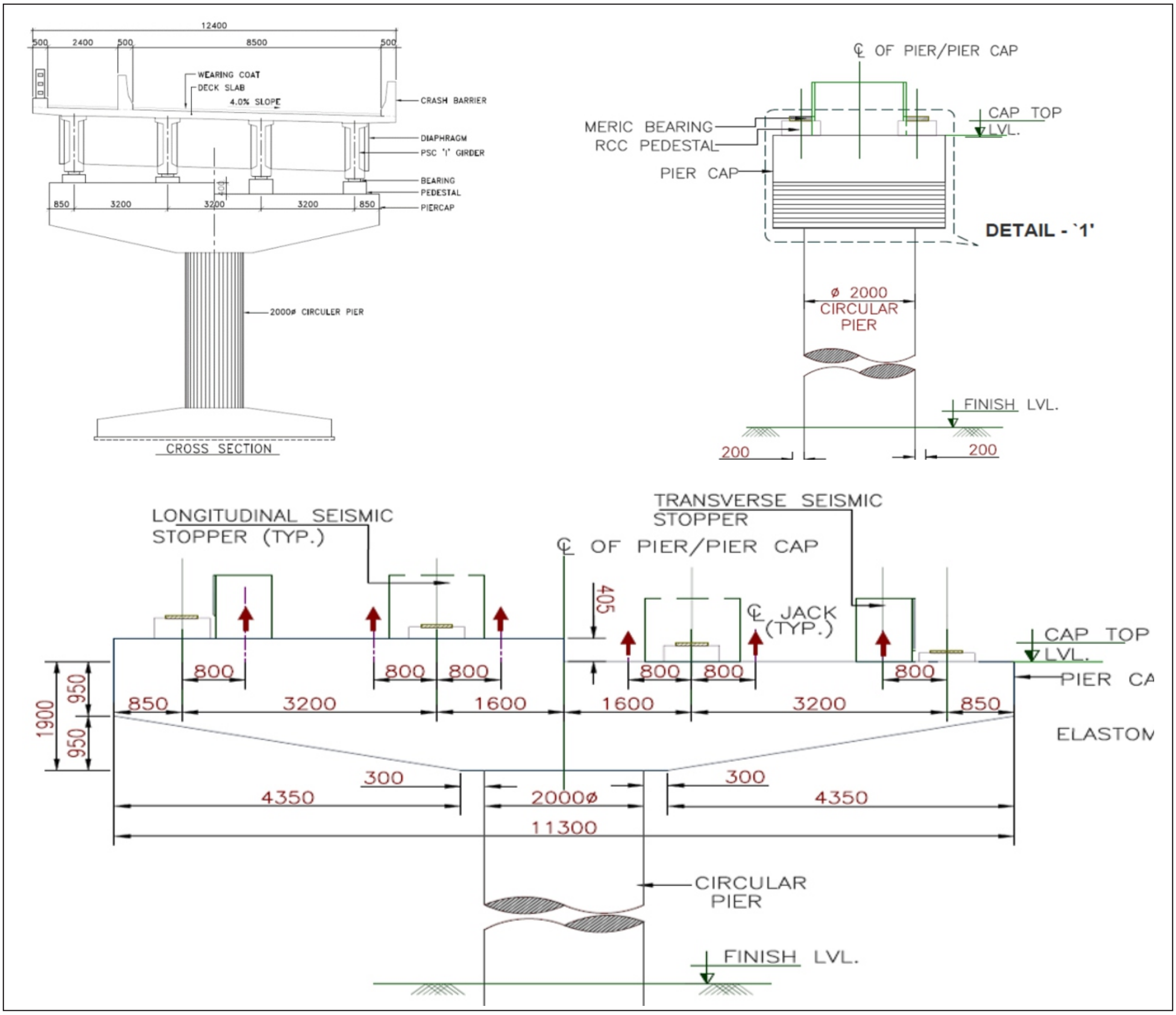
****

REPORT No. CF-47

Need for Giving Adequate Attention to Detailing

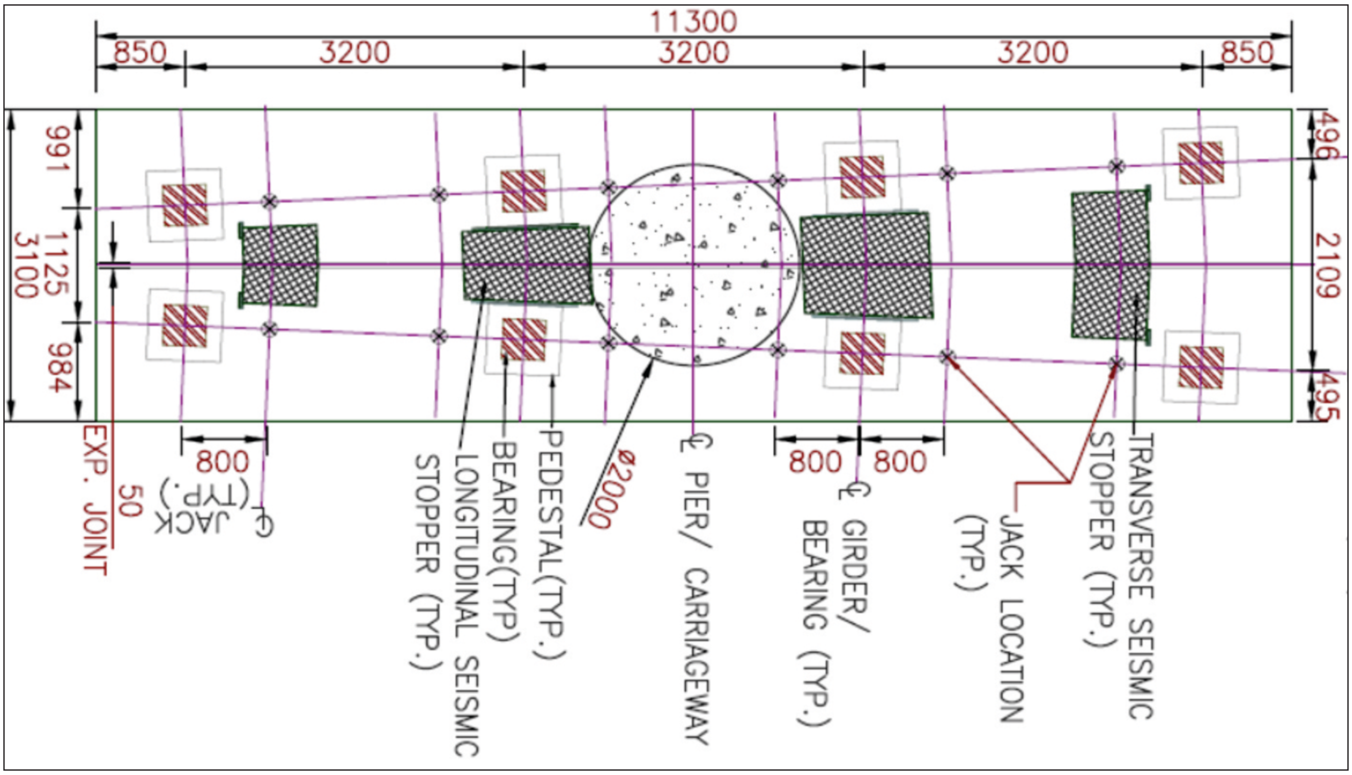
Introduction

This report is on a case study of a 4-lane flyover in a city with two separate carriageways in either direction. Bridge is on a curve. Spans are 35m. Curvature is tackled with straight PSC girders of equal length and adjusting the bearing centerlines with respect to pier centre (see bearing level plan below). Total width of flyover in either direction is 12.5m, including widening for curvature. Superstructure is supported on 4 prestressed precast girders. Each carriageway is supported on an independent RCC pier cap and Pot/PTFE bearings pier and open foundation. Substructure consisted of a single circular pier of 2 m dia with cantilevering RCC pier caps. To avoid large pedestal heights for outer girders, due to 4% super elevation for a vehicle speed of 60 kmph, one side of pier cap supporting two outer girders is provided with additional height of 400 mm. See sketch 1.



Sketch 1

Assuming girder lengths were maintained same by shifting bearing positions, see sketch 2, the radius of curvature works out to 400m which really is not a very sharp radius.



Sketch 2

Construction up to pier cap level progressed smoothly. Work up to pier cap level was completed in almost all the piers. Simultaneously Psc girders were cast in the casting yard. After readying 2 spans, A1-P1 and P1-P2, precast girders were brought to site and erected by crane from one side. Study of actual erection sequence indicated that placement sequence was haphazard. After placing them on bearing, next inspection indicated substantial cracking in pier caps at the junction with pier. Cracks were noted at all three locations A1, P1, P2. See photo 1.

Photo 1

It is noted that every crack originated at the junction of raised pier cap and progressed substantial downwards almost vertically except in one case it was slightly inclined. There were sympathetic cracks sometimes parallel to the main crack or sometimes at an angle. At this stage a thorough investigation of cracks was necessary recording widths and depths of cracks. A complete diagram of crack patterns, their extent as on the day, widths and depths should have been noted, however it was not done. Cracks developing in pier caps just after placing girders is rather unusual as at this stage pier caps are loaded to less than 25% of total load. This should have alarmed the concerned.

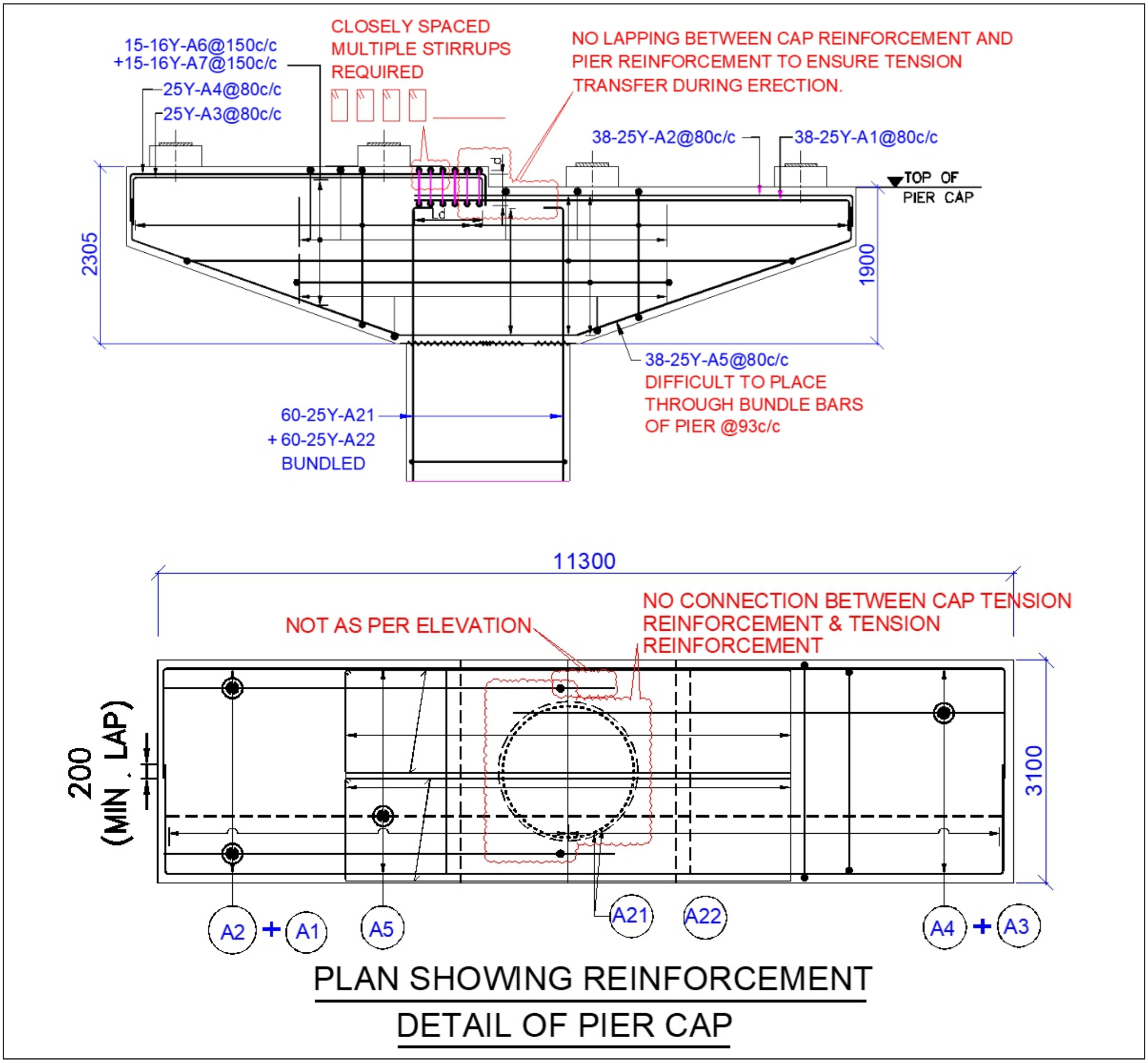
Photo 2

Such Cracks were seen on Every Pier Cap where Girders were Erected

All the drawings prepared by design consultant were approved by Proof Checker. Initial inspection by them did not lead to any clues. It was decided by them to fill the gaps with epoxy based crack fillers and observe. However, cracks reappeared, see photo 2. Rechecking of calculations was done by the same group of engineers which had done designing/checking initially.

After another two weeks two more spans were erected. After placing the girders same type of cracks developed in P3 and P4 pier caps. At this stage all erection was stopped by the authorities till the reason for such occurrences was found. It was decided by the authorities to appoint an independent agency to study the causes and suggest repair methodology.

Reinforcement details of pier cap are shown in sketch 3. Reinforcement provided on both sides of cantilevers is same and worked out on basis of smaller depth. So increasing the depth of pier cap was purely for functional reason and not to achieve any economy in reinforcement.



Sketch 3

Observations

a. Though concrete strength results were confirmatory to design, general condition of concrete did not look good. See Photo 3. This however would not have led to cracking.

Photo 3

b. Main top tension reinforcement on two cantilever sides of pier is in two layers each and separated vertically by 400 mm which means there is no direct transfer of stress from one side main reinforcement to another. Any transfer has to take place through concrete only. This could happen only if adequate closely spaced stirrups connecting the main reinforcement on two sides were provided (As marked on original pier cap reinforcement shown in Sketch 3). These were not provided. Though main reinforcement provided was adequate there was no mechanism for transfer of stresses from one side to another.

c. During erection phase there was imbalance in placements of girders see photo 4.

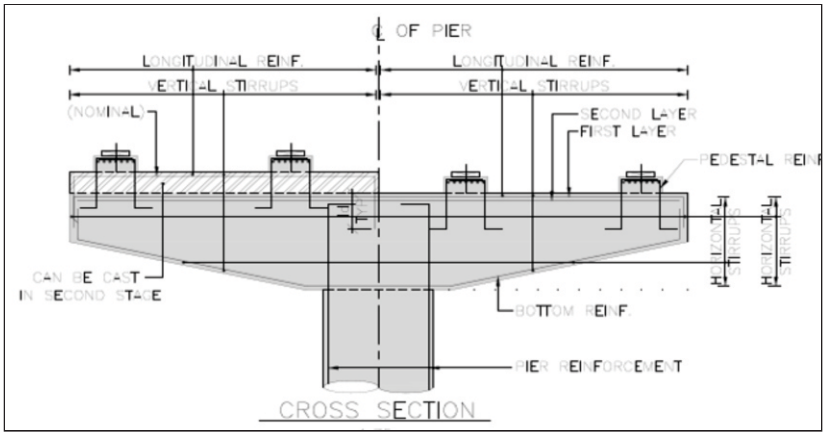
Photo 4

The resulting moment generated in cap was therefore transferred to pier. The pier reinforcement was stopped well short of pier cap tensile reinforcement (see mark up on the Sketch 3). Pier reinforcement did not extend/ lapped with cap tensile reinforcement. This led to cap cracking immediately after placement of girders. This happened when girders on raised pier caps were placed. There was no path for stress flow from reinforcement in cap to reinforcement in pier.

d. Some other difficulties in placing bars are shown in Sketch 3. This must have been tackled locally. However bottom bars are nominal.

e. Camber could easily be restricted to 2.5%, giving a design vehicular speed of over 45 kmph adequate in a city environment. This would have eliminated the need for raising the pier depth by 405.

f. Alternatively depth of pier cap structurally could be maintained same throughout so that main tension reinforcement is taken through. Additional concrete depth to cover for restricted pedestal height, could be provided with nominal steel. In this case lapping/continuation of pier reinforcement up to and into main cap reinforcement was easy (See sketch 4).

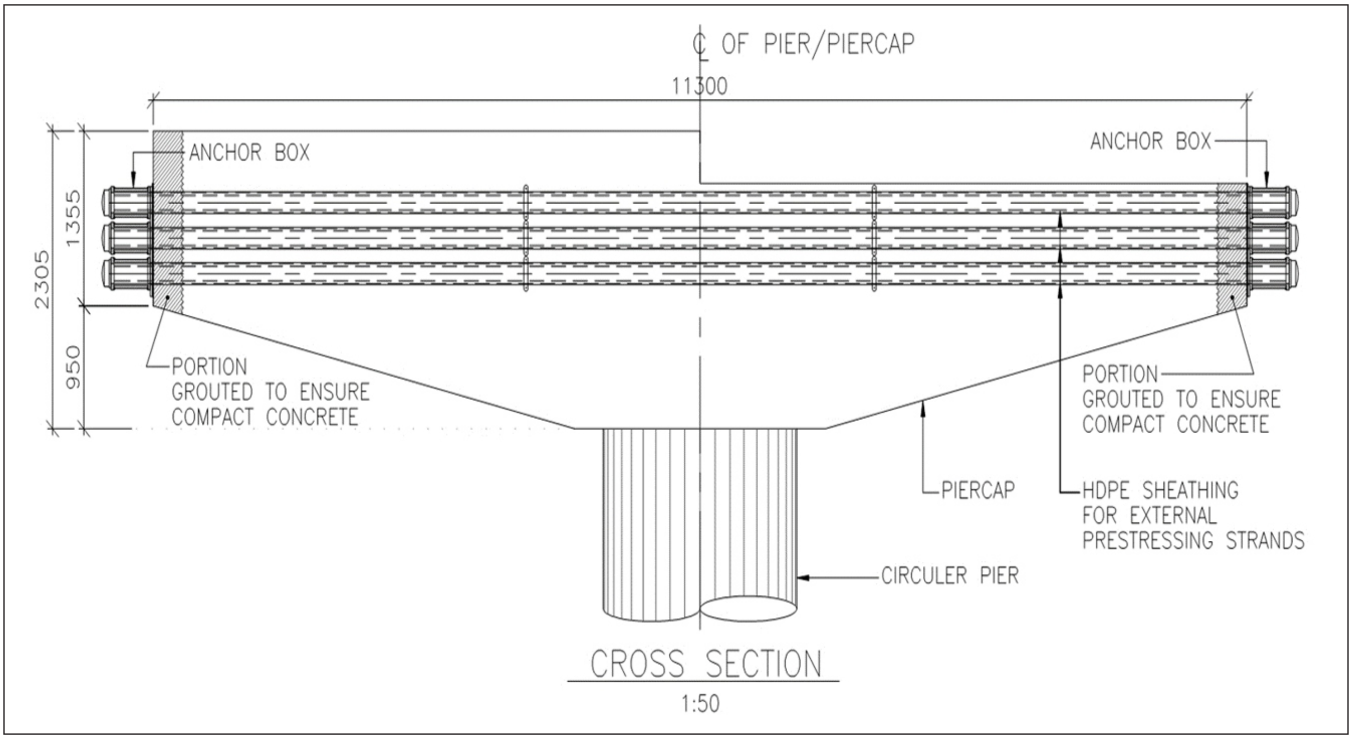


Sketch 4

g. If such distresses are observed with regularity in a particular element, it is always better to associate a third party with investigation, even if it is from within the organisation so that an independent view is available.

Recommendations

The only possible solution without dismantling the entire pier cap was to provide external prestress and render the internal tension reinforcement at the top of cap superfluous. This work including design of system was done through a specialised agency on each and every cap. See detail in Sketch 5.



Sketch 5

The rehabilitation is now complete. Bridge is also complete and thrown open to traffic. Rehabilitation of under construction bridge is always painful to engineering fraternity. In this case failure did not occur under service so there were no other consequences but it was still a failure.

Opinion of Expert Panel

The report brings out the vital importance of correct detailing of reinforcement. In this particular case, a stepped pier cap, which was required to limit the height of pedestals, under the outer girders, due to a 4% super elevation was constructed with wrongly detailed main tension reinforcement and failure on the part of the designer to understand the load transfer mechanism between the tensile reinforcement provided in stepped pier cap and unstepped pier cap portion and also failure to take the reinforcement from the pier above the tensile reinforcement of pier cap. Stirrups were not provided to ensure stress transfer between the upper and lower tensile reinforcements of the two pier cap levels in the absence any possible direct lapping. All these detailing errors led to the vertical cracking of the pier cap at the junction of its two stepped heights.

The report clearly discusses the cause of the cracking noticed in a few pier caps of the project, due to ineffective detailing of its reinforcement and suggests remedial measures to avoid such issues on future projects. In the case of this particular project in which a few pier caps were similarly distressed, epoxy based crack repairs followed by providing external prestressing to pier caps was the remedial measure adopted

The cracks appeared in the pier caps during girder erection, when the bridge was carrying only a small part of its intended design load. This indicates that there was a basic weakness in the way loads were being transferred from the pier cap to the pier. The investigation found that the extra depth provided on one side of the pier cap to accommodate super-elevation interrupted the continuity of the main tension reinforcement over the pier. Although the amount of reinforcement was sufficient in terms of strength, its detailing did not provide an effective path for transferring forces between the cantilever pier cap and the supporting pier. In addition, the lack of adequate connecting reinforcement and poor continuity between the pier reinforcement and the pier cap reinforcement created a weak zone at the pier-cap junction.

The strengthening scheme using external prestressing proved to be an effective solution, as it provided an alternative mechanism to resist tensile forces without requiring reconstruction. This case demonstrates the importance of proper reinforcement detailing, continuous load-transfer paths, checking construction-stage loading conditions, and carrying out independent reviews when similar structural problems are repeatedly observed during construction.

****

REPORT No. CF-48

Failure of False Steining of Well Foundation during sinking Process

1. Background

This report is about failure of 225mm thick RCC false steining, in case of a well foundation of a railway bridge across a major river. False Steining is a temporary, additional layer of steining which is built above the permanent well steining. It is used in well sinking to extend the wall height above water level, facilitating further sinking where well cap can be cast in dry state at a level below the prevailing water level.

The circular well foundation under discussion is 27m deep with 15m outer diameter with 2.35m thick RCC steining. The well foundation is designed to rest on hard rock. The said foundation supports a deck with steel concrete composite girder span of 37.5m from one side and a open web girder steel composite truss of about 80m on other side designed for rail loading. The height of bridge from rail level to well cap top level is around 45m and RCC circular hollow pier is proposed over well cap. The total length of bridge is 342m long, having 8 spans, comprising of 5x37.47m + 1 x 79.68m + 2x37.47m, all simply supported spans. Details of false steining provided in this case is shown in Fig. 1 below.

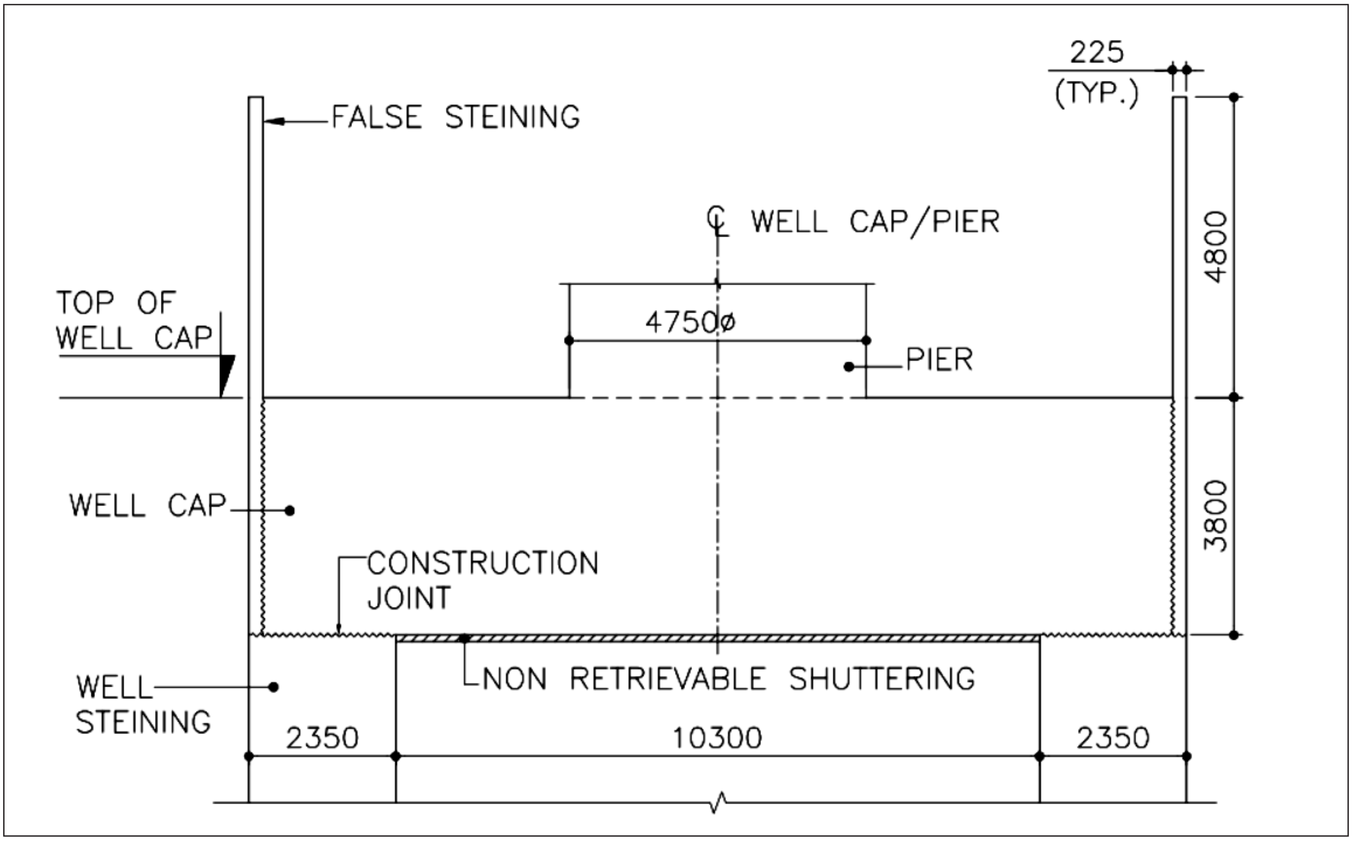


Fig. 1 : Dimensional details of false steining

The sinking of well foundation was in progress, when this problem occurred in one of the well foundations. The sinking was started around two years ago i.e. in Feb'2024. As per Geotech report, top 15 to 20 m strata at this location consisted of bouldery deposits comprising cobbles, pebbles, and boulders intermixed with a non-cohesive matrix of soil and sand. Below this layer strata consists of medium to hard rock. The failure occurred at the junction of false steining and well steining after sinking of well for about 24m. Only 3m sinking was balance. Total height of false steining cast was around 7m. Fig. 2 shows the position of well foundation when this failure occurred.

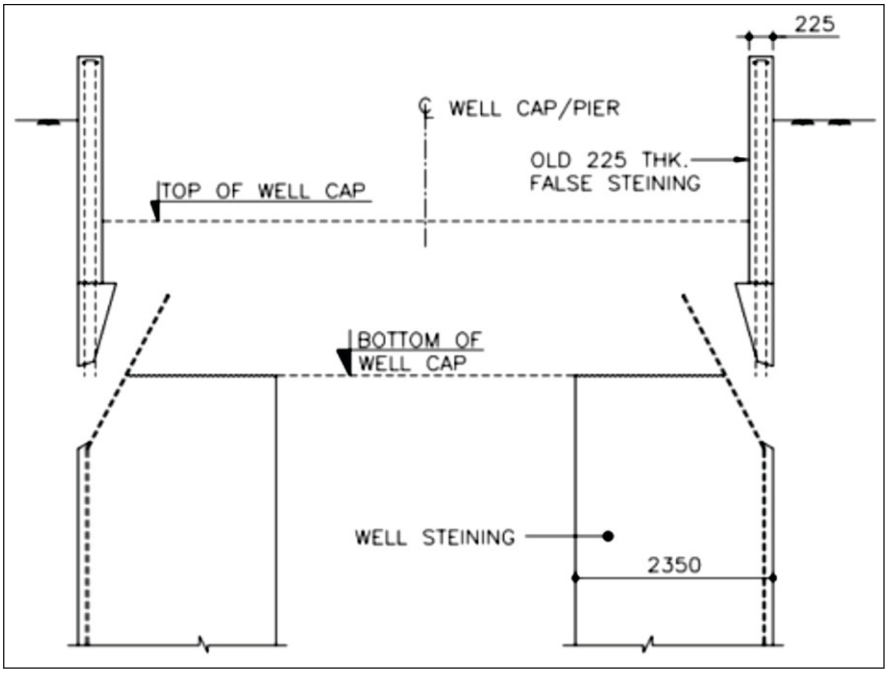


Fig. 2 : Dimensional details of well foundation at the time of False Steining Separation from well

2. Details of distress noticed on false steining

At the depth where this failure occurred, the sinking rate was low, due to encountered hard strata over about 50% of base area. It is learnt that when this failure occurred, there was a sudden sinking of well foundation by about 900mm. During this sudden sinking, well foundation went down but the false steining remained where it was and it got detached from well steining. Following are the major observations:

a) Reinforcement detailing of the steining top and false steining as per GFC drawing is shown in Fig. 3.

b) Failure occurred at the interface between the well steining and false steining (Fig. 4 & Photo-1).

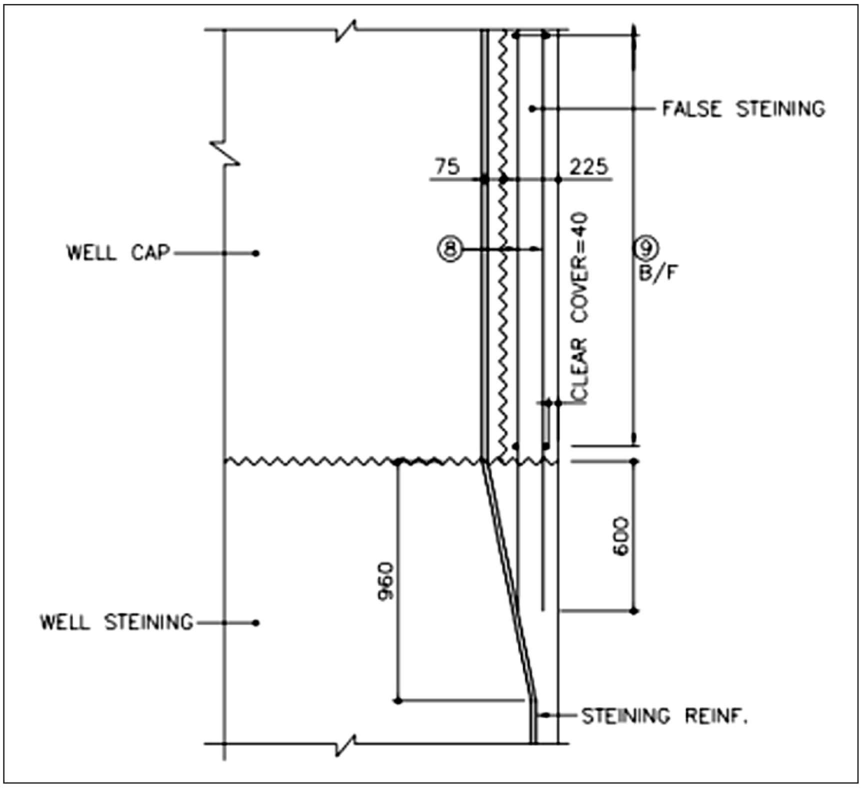


Fig. 3 : Reinforcement Detailing of False Steining

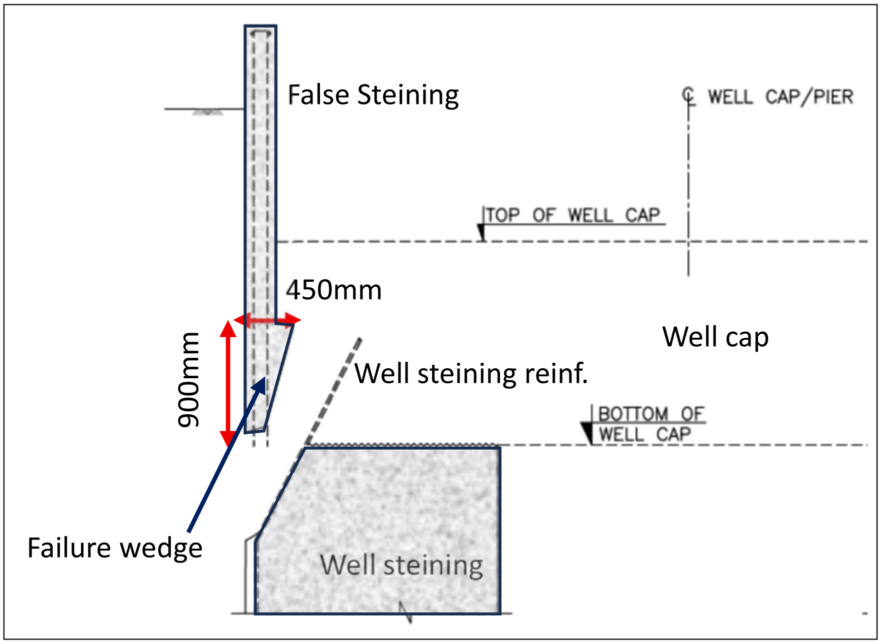


Fig. 4 : Sketch showing failure at junction

c) A wedge-shaped portion of concrete, approximately 450 mm wide and 900 mm deep, came out from the outer edge at the top of the well steining as shown in Fig. 4.

d) Few vertical cracks were visible in false steining, which creates doubt about concrete quality (Photo-2).

e) The cover to outer vertical bars of well steining from inner face of false steining was noted as 200 mm instead of 75mm, shown in GFC drawings (Photo-3 & Fig. 5), which indicates poor workman ship.

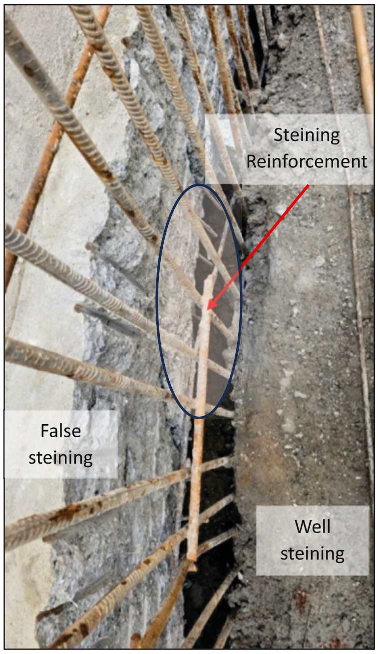


Photo - 01 : Actual site picture at failure location

Photo - 02 : Cracks in false steining

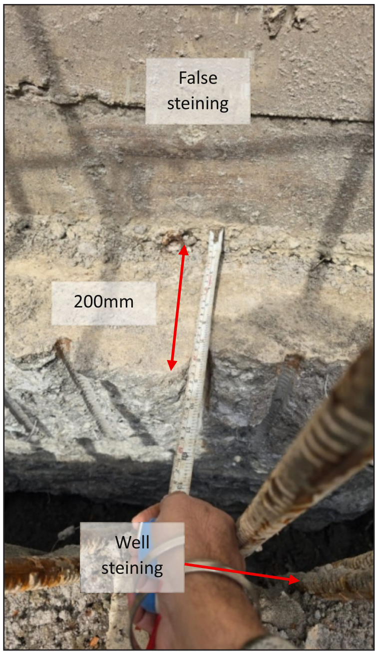


Photo - 03 : Cover to outer vertical bars of well steining is 200 mm instead of 75mm

3. Likely Cause of Distress of false steining

Following may be the possible causes of failure of false steining:

a) The reinforcement provided in false steining was anchored inside the well steining by 600mm (Fig. 3).

b) The reinforcement for the well steining was improperly positioned and placed 200 mm away from the inner face of the false steining (Fig. 5). Which further makes the section week in tension.

c) The presence of cracks indicates possible poor concrete quality and workmanship, which may have contributed to the distress.

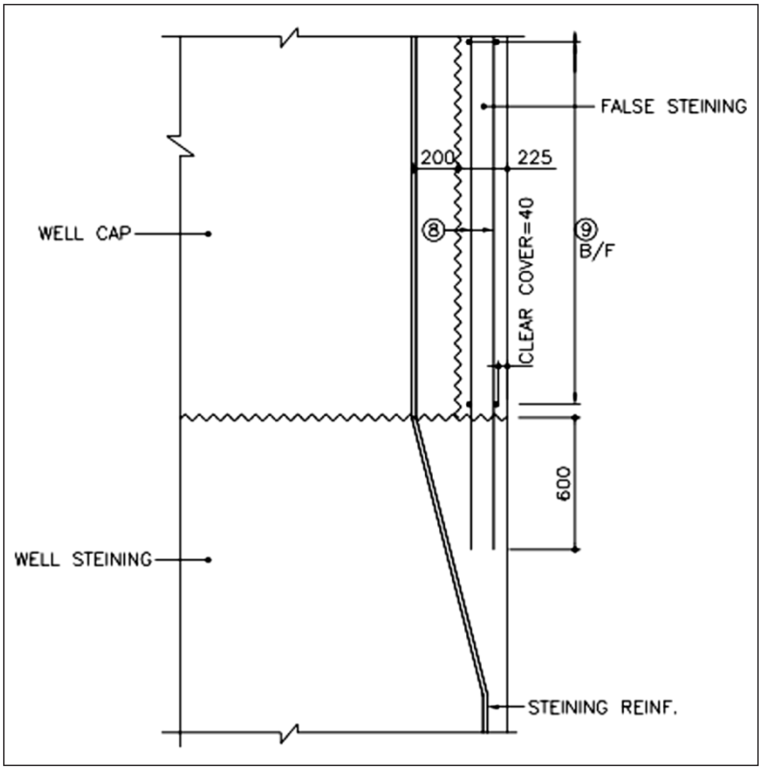


Fig. 5 : Detailing at junction of false steining well (As per site)

4. Remedial Measures Undertaken

The following remedial measures are recommended:

a) Provide temporary support to the distressed false steining using suitably designed steel beams resting on sandbags at ground level (Fig. 7 & Fig. 8).

b) As excavation around the well/false steining is not feasible due to site condition, exposed reinforcement of well steining at the failure location shall be protected using Conbextra GP2 grade concrete or its equivalent to prevent corrosion in future.

c) Construct an additional layer of false steining inside the existing (distressed) false steining, with reduced height,

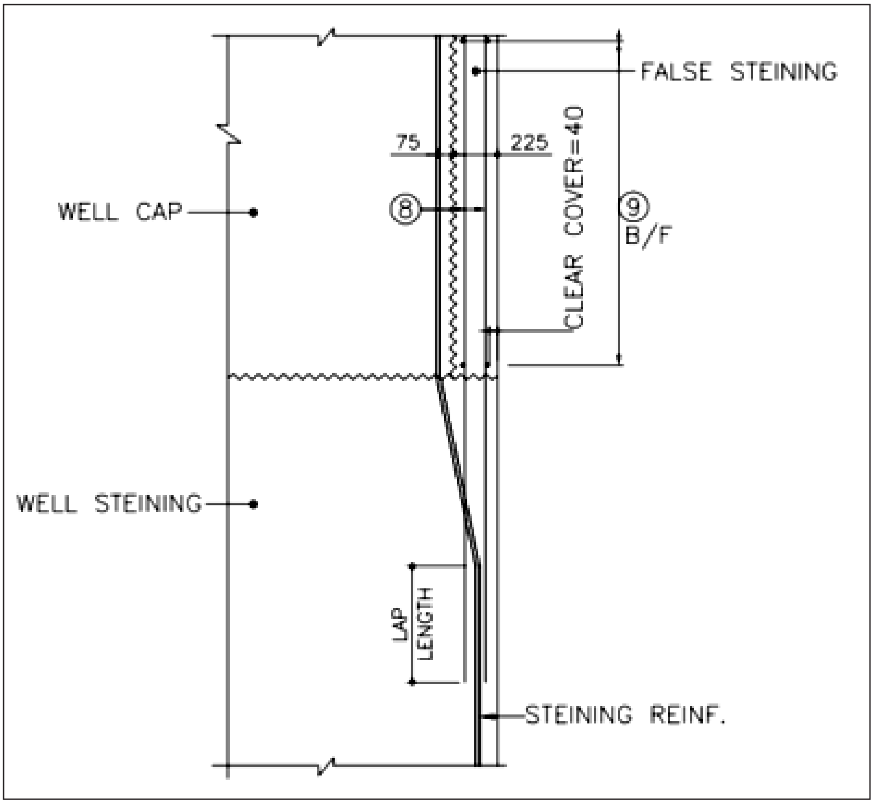


Fig. 6 : Improved detailing at junction of false steining

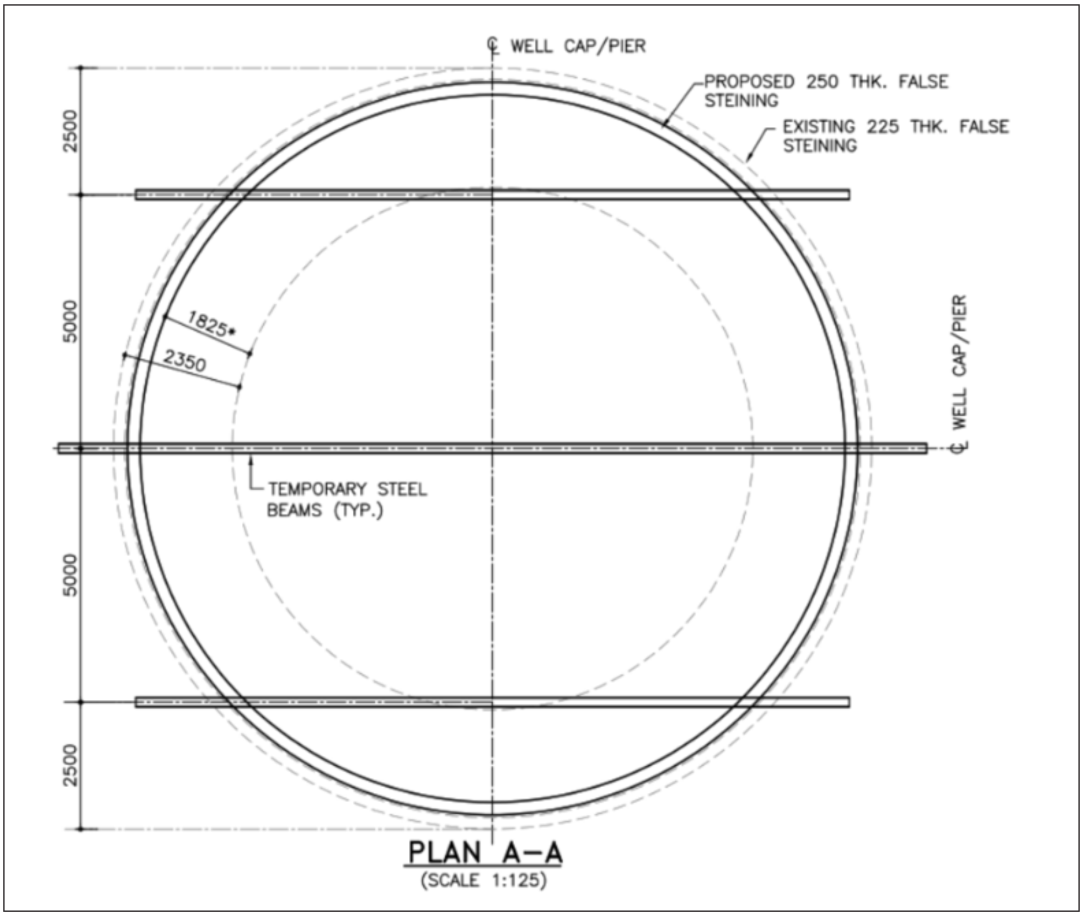


Fig. 7 : Temporary supporting arrangement for the distressed false steining

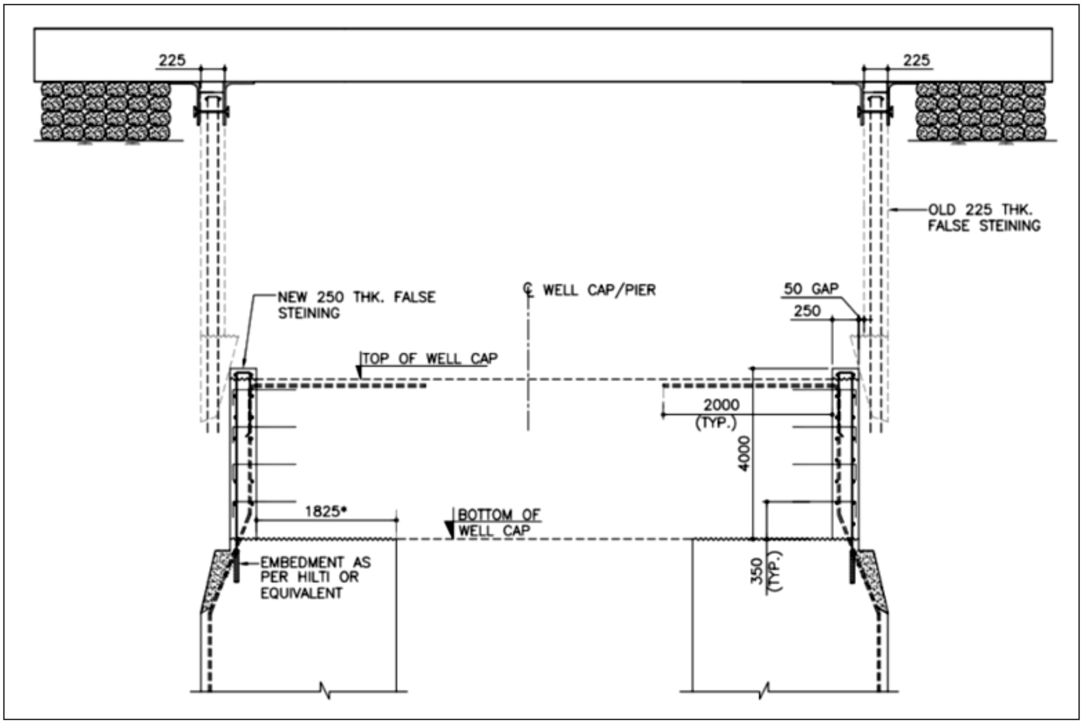


Fig. 8 : Sketch showing repair method

to prevent soil from escaping through the gap formed between the distressed false steining and the well steining (Fig. 8).

d) Refer Fig. 8 for proposed repair strategy

5. Lesson Learnt

a) Though the anchorage length is sufficient and satisfy the codal provisions, but detailing should have been improved at this junction by providing proper lap with well steining reinforcement. Fig. 6 shows the improved detailing which should be followed.

Opinion of Expert Panel

The report brings out the importance of correctly detailing the reinforcement from false steining into the well steining. In this particular case, the false steining separated away from the well steining when the well 'jumped down' very close to its founding depth. Poor detailing of the false steining reinforcement and inadequate lap length with the steining reinforcement of well, and also having a clear cover of 200mm to steining reinforcement when 75mm was specified in the design significantly abetted the failure and separating away of the false steining.

The remedial measures adopted to allow further construction of well and well cap used a temporary support arrangement for separated away old false steining and reconstruction of a new false steining, with correct detailing, inside the old false steining.

****

About the CROSFALL Newsletter

CROSFALL is a newsletter created by Indian Association of Structural Engineers (IAStructE). Its purpose is to share lessons learnt from structural failures, near-misses and safety concerns. CROSFALL is greatly encouraged and inspired by CROSS (Confidential Reporting on Structural Safety), UK, which is a collaborative effort of three institutions (IStructE, ICE and HSE). There is however no connection between CROSFALL-IAStructE and CROSS-UK.

CROSFALL has a confidential reporting system, which allow safety issues and failures to be reported by professionals, without exposing their identity. Any identifiable details, such as a project, product, individual or organisation, remain completely confidential to CROSFALL editorial team. Reporters' personal information will be collected to only verify the contents of the report, and to communicate with the reporter as and when necessary. The newsletter will report only failures and safety related issues with the objective to learn lessons from such failures and to help prevent future structural failures, by providing insight into root causes of such failures and spurring the development of safety improvement measures. CROSFALL team will depend on professionals to submit reports, whenever they can share their concerns about what they witness around or what they experience on any real-life projects. Anyone involved in the construction industry is welcome to submit a report. The more reports submitted, the better CROSFALL can identify and quantify safety issues across the industry. This will help the entire industry to learn lesson from CROSFALL publications

What can be reported?

- Structural failures,
- Poor Design and Detailing, Lack of Seismic Safety in planning
- Safety concerns about high risk erection schemes at Site
- Safety concerns on Temporary Works
- Near misses or observations relating to procedures followed at site, which may lead to failures or collapses.
- Unethical practices in the profession.

To submit the report :

Visit : www.iastructe.co.in/crosfall.php

E-mail : crosfall.iastructe@gmail.com

Disclaimer :

The objective of this newsletter is to help professionals to make structures safer. This is achieved by publishing information about failures and about unethical practices, based on the confidential reports received by IAStructE and information available in the public domain. IAStructE can not be held liable for the veracity of the information given by the reporter. As this document is based on the Confidential reporting system, the reporter's name and identity as well as the project name, location and identity will not be divulged under any circumstances. Expert Panel opinions given in this document are those of the group of individual experts in the field and not that of the association. IAStructE cannot be held liable for the opinions expressed herein. This newsletter is intended for those who will evaluate the significance and limitations of its contents and take responsibility for its use and application. No liability (including negligence) for any loss resulting from opinions/informations given in this newsletter is accepted.