Efficient Working of Building Services along Expansion Joint

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Abstract— In the Construction of New Multi-Storied Hospital on Kondhwa Road, Wanawadi, Pune, as per functional requirements, involves construction of various buildings such as Main Clinic, Civil OPD, Dental Centre (CMDC), Doctor's Mess, and other buildings. All the large building structures consists number of structural crumples interconnected through 50mm expansion joints. All the buildings comprise various building functional services such as electrical conduit, firefighting, structural waterproofing expansion joint treatment, false ceiling. An expansion joint or movement joint is a precautionary assembly designed to safely absorb the heat-induced expansion and contraction of construction materials, to absorb vibration, to hold parts together, or to allow movement due to ground settlement or earthquakes. It is found that, in the building functional services, there is requirement of provision of respective flexible assemblies that can assure safety to these services from various stresses which may cause due to thermal expansion, seismic movements, etc. at positions of expansion joints. Also, various work practices inclusive of discrepancies are found that had need of deployment of skilled labour force. After various findings, effective solutions of flexible assemblies for the respective functional services passing across expansion joint are resulted. In case of work practices, problems are rectified and skilled labour force is deployed.
The purpose of this paper is to provide efficient working of building functional services passing across expansion joint between different crumples of building.

Key words: Expansion Joint, Waterproof Expansion Joint System, Firefighting, Electrical Conduit, Elastic Assembly, Flexible Electrical Conduit, False Ceiling Joints

I. INTRODUCTION

Concrete expands & shrinks with variations in moisture and temp. The overall affinity is to shrink and this can cause cracking at an early age. Uneven cracks are unpleasant and difficult to maintain but usually do not affect the integrity of concrete. The Joints are pre-planned cracks. Any joint, as in a physical break or gap between members, in a concrete structure or building is a potential weak link which may lead to serviceability problems, lack of durability or structural failure.

An expansion joint or movement joint safely absorb the heat-induced expansion and contraction of construction materials, to absorb vibration, to hold parts together, or to allow movement due to ground settlement or earthquakes. They are commonly found between sections of buildings, bridges, sidewalks, railway tracks, piping systems, ships, and other structures.

In many situations, they are necessary requirement (e.g. to accommodate anticipated differential movement between members) and are sometimes regarded as a necessary evil. Frequently, problems arise because they are given insufficient attention by designers both in terms of their location and detail design.

Expansion Joints provided to accommodate the expansion of adjacent building parts and relieve compressive stresses that may otherwise develop. Building structures facilitates various services such as firefighting, electrical conduit, false ceiling, waterproof joint treatments depending upon functional requirements that may interfere in efficient performance of expansion joint if they pass across it. The expansion joint system should work appropriately for the thermal expansion of various building material and seismic movement.

The aim of the study is to maximize the efficiency of expansion joint & its advantages in various aspects.

II. PROBLEM STATEMENT

- The Building structures facilitate various services such as firefighting, electrical conduit, false ceiling, waterproof joint treatments depending upon functional requirements.
- These services undergo interfere of efficient performance of expansion joint as they pass across it.
- The expansion joint system and the services passing should work appropriately for seismic and temperature stresses at expansion joint.

III. OBJECTIVES

1) To facilitate an elastic assembly for electrical conduit passing across the expansion joint to sustain thermal expansion and seismic stresses induced at crumple joints.
2) To intimate the importance of skilled labour force in work practices to be executed along expansion joint.
3) To allow movement of different grids of false ceiling on other sides of expansion joint.
4) To provide an efficient work practice to structural waterproofing expansion joint treatment between circular and flat column having expansion joint more than350mm width.
5) To provide flexible connection to eliminate the thermal expansion and seismic movements to firefighting services comprising water rising mains at crumple expansion joints.

IV. METHODOLOGY

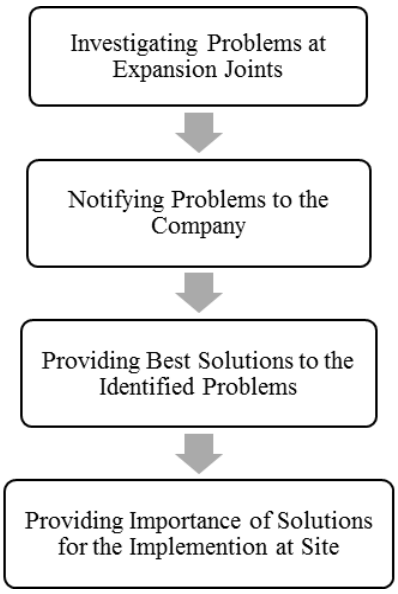

Fig. 1: Methodology

A. Electrical Conduit:

Problem Identified: At Site, mild steel non-flexible rigid conduit is used for electrical conduit passing throughout the slabs of different crumples of buildings. The MS conduit maintains permanent bend, and cannot flex freely for any elastic deformation or seismic movement in the crumples.

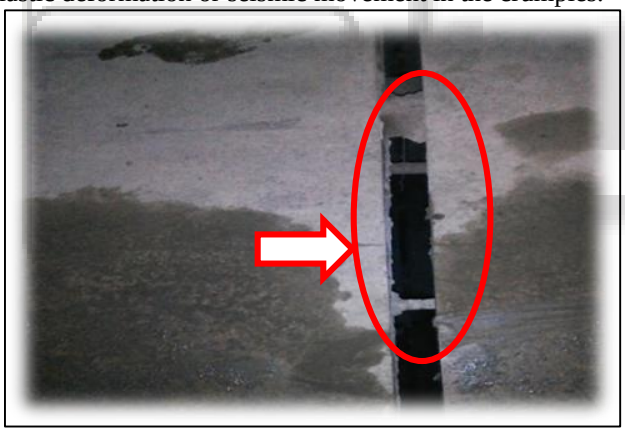

Fig. 2: Rigid Conduit through Slabs

Solution identified: Flexible metallic conduit (FMC, informally called Greenfield or flex) made by the helical coiling of a self-interlocked ribbed strip of GI or steel does not maintain any permanent bend, and can flex freely.

Fig. 3: Flexible Arrangement to Conduit

B. Labour Works

1) Problems Identified:

1) Inappropriate position of Joinery Works such as doors along Expansion Joint shown in the drawings.
2) Non-provision of expansion joint gap within the external block masonry at Block-1.
3) Change in the orientation of expansion joint at Dental Centre(CMDC).
4) Tightened Screws on steel plates along expansion joint at Dental Centre.
5) Provision of Continuous RCC lintels and bands throughout expansion joint at Block-1.
6) Improper installation of RCC Chajjas/Slabs over heading expansion joint at Terrace floor of CMDC.
7) No Detailed drawings and specifications for the services along expansion joint.

2) Solution Identified:

1) It is impossible to provide expansion joint at doors as shown in the architectural drawings. Hence, position of Doors need to be shifted away from the joint.
2) At external face of Block-1, whole masonry along expansion joint needs to be broken into two parts to achieve purpose of movement.
3) There is need of skilled labour force so as to check the decision taken technically viable.
4) Need of skilled labour deployment considering knowledge of proper working arrangements.
5) The Continuous RCC members needs to be broken in such a way that 50mm gap is achieved.
6) Skilled labour deployment is necessary in proper execution of works for the services.
7) Skilled labour deployment is necessary in designing and drafting drawings and specifications for the services.

C. False Ceiling

1) Problem identified:

At Site, False Ceiling Services are intended to provide at different rooms of Main Hospital Building as well as OTM buildings. The expansion joint exists at all the buildings. There is no provision of any elastic assembly (not even mentioned in drawings) is provided for False Ceiling grid works along expansion joint within buildings. It may undergo damage to the aluminium grids and indirectly to the whole room ceiling tiles due to temperature or seismic stresses. It needs flexible section which would facilitate the movements along its cross section.

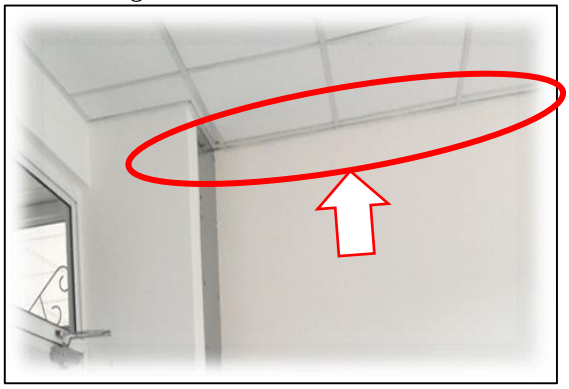

Fig. 4: False Ceiling at Dental Centre

2) Solution Identified:

Expansion Joint for false ceiling is an effective solution. Expansion joint for false ceilings, comprising aluminium side sections and an interchangeable insert in the centre, able to take up large multidirectional movements. Especially suitable for suspended ceilings. Selected section JDV 4.14 is of 'Vedatechnic' make consisting aluminium side angle sections and top quality flexible PVC insert (Vedaflex). It is useful for joints in false ceilings or suspended ceilings with a gap up to 350 mm. The make is an assembly that is designed to absorb safely expansion and contraction of different planes caused by heat. It also absorbs vibration and permit movement due to earthquakes and ground settlement. The consulted section can be installed exactly in similar way of installation of normal aluminium grids.

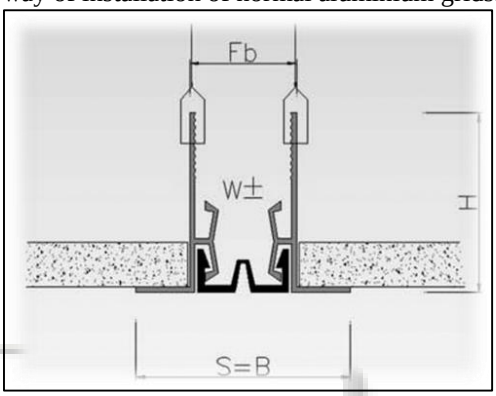

Fig. 5: Flexible s/c for false ceiling

D. Expansion Joint Treatment between Circular and Flat Column

1) Problem Identified:

At Central Atrium of MHB, Block 1 to 7 is joining to Central Atrium forming expansion joint between flat columns and circular columns. There is no appropriate drawing is available for treating expansion joint between circular and flat columns. The forming joint width is above 350mm. The CHRYSO polyband used in joint treatment has width limitation of 400mm only. The polyband requires of minimum 50mm bearing on both sides of joint which is not available at the portion of circular and flat column contributing expansion joint.

Fig. 6: Columns at Central Atrium

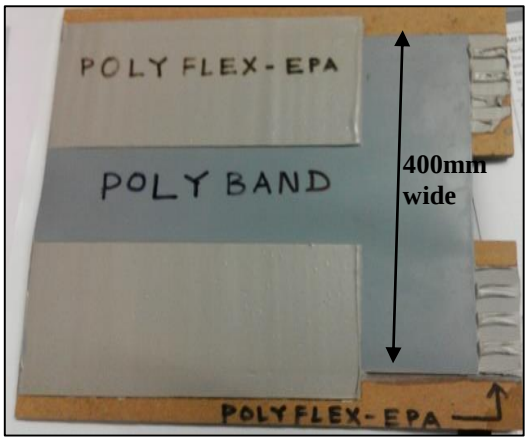

Fig. 7: Expansion Joint Treatment (CHRYSO)

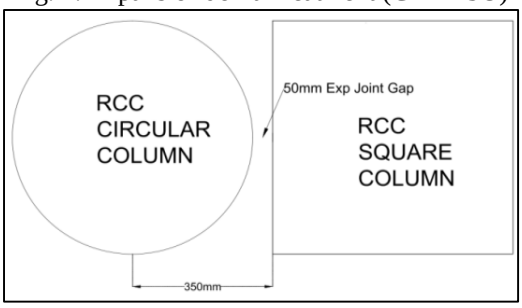

Fig. 8: Column layout

2) Solution Identified:

Providing Aluminium Composite Paneling (ACP) to reduce joint width is an effective solution. It is a very rigid, durable and strong material although it is very light in weight, unbreakable, stain resistant, weather resistant material. It can also provide aesthetically good appearance. ACP installation fittings can be done as shown in below Fig.9. MS 40 X 40 X 4mm square tube can be installed vertically so as to rectify the cantilever moment of ACP adjacent to joint. After that, the directed treatment including CHRYSO treatment, steel plates (over it) can be installed.

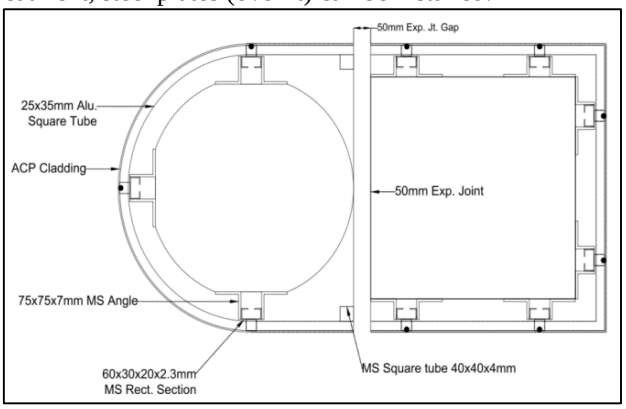

Fig. 9: ACP Arrangement

E. Fire Fighting

1) Problem Identified:

At Site, Firefighting and sprinkler system involves water conveyor network system for each floor. The water conveyor network system is suspended at ceiling portions of RCC structure & passing into rooms with rigid connection to the masonry walls. There is no provision of any elastic assembly (not even mentioned in drawings) for firefighting water conveyors passing from one crumple to other of

building. It may undergo damage due to temperature or seismic stresses. It needs flexibility along its cross section.

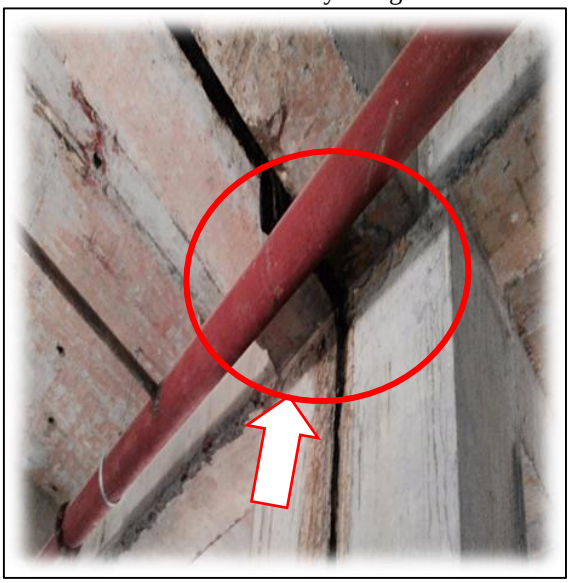

Fig. 10: Fire Fighting Rising Main at Expansion Joint

2) Solution Identified:

Metallic hose joint (Make: Starflex) is an effective solution. A metal hose is a flexible metal line element. It can withstand high pressure and provide maximum leak tightness on account of their material. It also exhibits corrosion resistance and pressure tightness. The metallic hoses are used as economical, flexible connecting elements that permit movement, thermal expansion and vibrations, and that can be used as filling hoses. Corrugated hoses are used to convey liquids or gases under pressure or as vacuum lines. They are also referred to as pressure hoses. Their distinctive design achieves both flexibility and pressure resistance. At site, as per the contract agreement, it is stated that, the piping/conveyors must be capable of bearing test pressure of 10.5Kg/m^2. or lesser. The found solution of Metallic Hose Joint can bear test pressure of 15Kg/m^2. The consulted section can be joined by bolting flanged ends of both the particulars.

Fig. 11: Metallic Flexible Hose Joint

V. Results and Discussions

A. Electrical:

Flexible metallic conduit with connectors provide required flexibility to conduit as well as the flexible conduit can be replaced when required. Considering adoptability, easily available and low cost, it has been implemented at site by the company.

Fig. 12: Flexible Conduit Installation

Fig. 13: Flexible Conduit at Block-2

B. Skilled Labour Works:

Suggestion in practice of shifting of shifting position of doors from the joint become productive without any impact.

Fig. 14: Shifted Position of Door

At external face of Block-1, whole masonry along expansion is broken into two parts, and the purpose of efficient movement is achieved.

Fig. 15: Block work at Expansion Joint

Change in orientation of expansion joint may cause damage to the adjoining works such as masonry, wall finishes, structural glazing, so deployment of skilled labour is the appropriate solution.

Loosened screws would not obstruct movement of steel plates along expansion joint, otherwise it may cause cracks on walls surface where steel plates are fitted. Loosening of screws is a good preventive solution executed.

Fig. 16: Loosened Steel Screws

The continuity of continuous RCC members such as bands, lintel within expansion joint is broken to achieve movement purpose, otherwise, may cause damage to whole walls and their finishes through cracks and more damages during the thermal or seismic movement.

Fig. 17: Discontinued RCC band

Improper installation of RCC Chajjas/Slabs over heading expansion joint at Terrace floor of CMDC resulted into cracks at plaster. Skilled labour deployment is effective solution in proper execution of such works.

Practical constraints can be considered in design if skilled labour force is deployed in designing and drafting drawings and specifications for the services.

C. False Ceiling:

The 'Vedatechnik' JDV 4.14 section inclusive of PVC flexible insert is designed to absorb safely thermal movements. It also absorbs vibration and permit movement due to earthquakes and ground settlement.

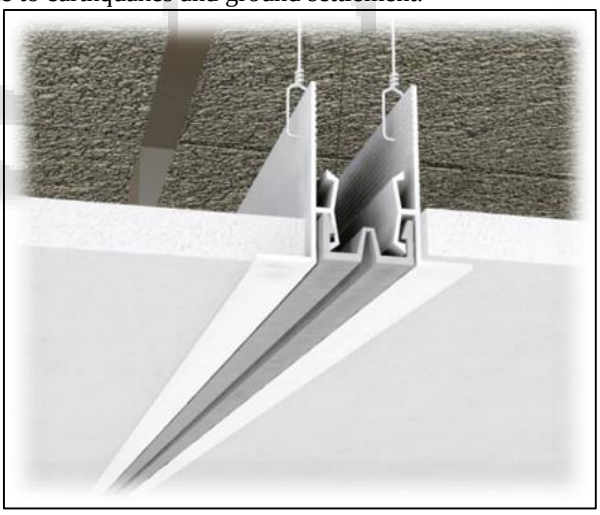

Fig. 18: Vedatechnik JDV 4.14

Implementation is not done at site yet as it is manufactured in France and resulting delay in access.
It costs about Rs.950 per running metre.

D. Expansion Joint Treatment between circular and flat column:

Aluminium Composite Paneling (ACP) can reduce the resulting large joint width. It can also provide aesthetically good appearance which is required at reception area at Central Atrium. Also, It is a durable, strong, light in weight, unbreakable, stain resistant, weather resistant material.
The arrangement costs upto Rs. 3100 per m^2. It is under implementation process.

E. Fire Fighting:

There is no provision of any elastic assembly (not even mentioned in drawings) for firefighting water conveyors passing from one crumple to other of building. It may undergo damage to whole fire sprinkler network by movement due to temperature or seismic stresses.

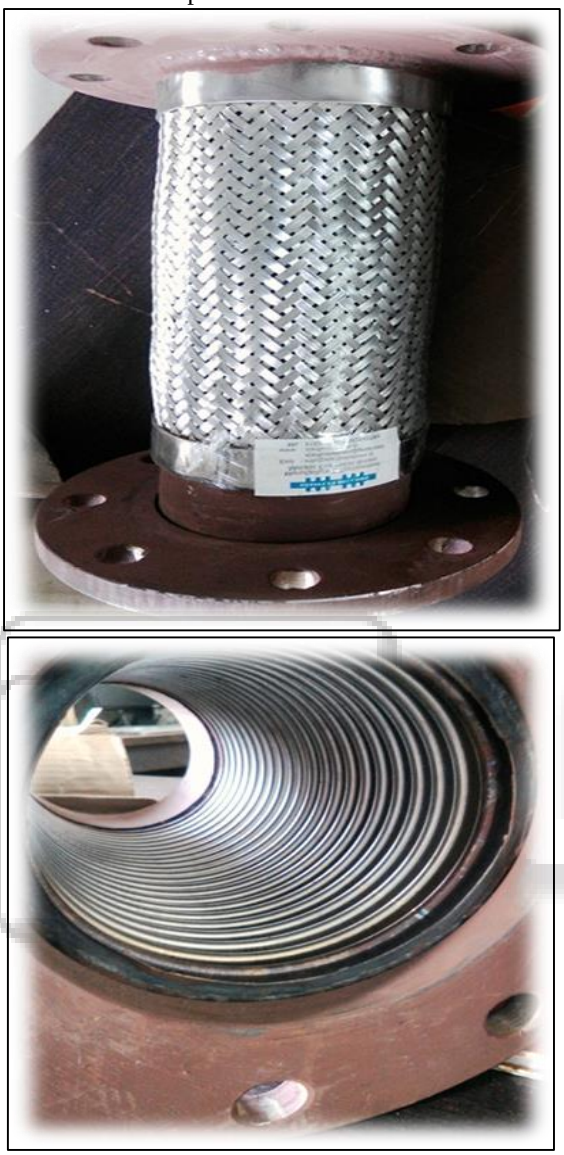

Fig. 19: Metallic Flexible Hose Joint

A Metallic hose joint as a flexible metal line element, permit safety against movement, thermal expansion and vibrations. It can also withstand high pressure and provide maximum leak tightness of water. It also exhibits corrosion resistance. The assembly bears required pressure mentioned in contract agreement.

The joint for diameter of 100mm costs upto Rs.2100 per number. It varies with sizes of diameter.Its implementation is waiting due to company policies.

VI. Conclusion

1) Provision of flexible metallic conduit for electrical conduit passing across the expansion joint facilitated required elasticity to sustain thermal expansion and seismic stresses induced at crumple joints.
2) Intimated importance of skilled labour force and rectifications in work practices along expansion joint provides beneficiary outcomes.
3) The Vedatachnik JDV 4.14 aluminium section allow movement of grids of false ceiling passing across expansion joint.
4) Provision of the certain ACP arrangement reduces width of expansion joint from 350mm (or more) to 50mm between circular and flat column so as to provide an efficient work practice to structural waterproofing expansion joint treatment and good appearance of ACP.
5) The flexible metallic hose joint provide flexibility to eliminate the thermal expansion and seismic movements to firefighting services comprising water rising mains at crumple joints.

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