Evaluation of cracks in building at southern area of Iraq

Dr. Ryaidh –A Abass Al Muthanna University
Ms. bassim .J Abasss Al Muthanna University
Abass A. Noor Al Muthanna Unversity

Abstract

All reinforced concrete cracks, generally starting at loads well below service level., and possibly even prior to loading due to restrained shrinkage. Flexural cracking due to loads is not only inevitable, but actually necessary for the reinforcement to be used effectively.

The quality of concrete suffers occasionally either during production or during service condition resulting in distress.

The deformity in structure happen during drying shrinkage, thermal stress & weathering is often in south area of Iraq focuses to evaluate the cracks in all parts of the buildings at high temperature zones.

This study focus on cracks in buildings at high temperatures zones, classifying these cracks according to it's effects on this building.

So the sampling of these buildings are taken in ALSAMAWA city, it is observed that type on finishing have big effect on the minimizing some cracks in some parts of buildings because the finishing materials decrease transporting the temperature to structural member.

الخلاصة:

كل الشقوق في الخرسانة المسلحة تبدأ عموما عند بداية تحميلها، و بالإمكان أن تبد هذه الشقوق قبل مرحلة التحميل بسبب الانكماش المقيد الخرساني ،الشقوق الإنشائية نتيجة الأحمال لا تكون فقط محتومة ، ولكن في واقع ألأمر تكون ضرورية ليكون التسليح فعال في المنشأ الخرساني.

أن الأضرار التي تحصل خلال فترة حياة إنشاءها تحصل إثناء إنتاجها أو خلال فترة الخدمة و أن الأضرار الحاصلة لها طبقا للانكماش الحاصل لها بسبب الجفاف أو الأجهادات الحاصلة بسبب التغييرات الحرارية في الطقس و التي غالبا ما تحصل في مناطق جنوب العراق .

أن هذه الدراسة اتجهت نحو تقييم الشقوق في الأبنية في المناطق ذات الحرارة العالية و التي صنفت تبعا لتأثيرها على هذه الأبنية وهذا ما حصل، حيث اخذت نماذج من أبنية في محافظة المثنى كنموذج لهذه المناطق الحارة، لوحظ بان لنوعية مواد الانهاءات تأثير كبير في تقليل بعض الشقوق في بعض الأجزاء الخرسانية في الأبنية بسبب إن مواد الانهاءات تقلل من نقل الحرارة إلى الأجزاء الخرسانية .

1-Introduction

All concrete structures crack in some form or the other, but the cracking in concrete structures may be is not necessarily a cause for accusing designer, builder or supplier. Cracks that are acceptable for building structures may be acceptable for water- retaining structures. The latent defect in concrete structures may be caused by inadequacy of design materials or construction practices which may not become evident until some time after it's competition.

The immediate cause of deteriorate may be chemical action or corrosion of reinforcement.

The incompatible dimensional changes caused by draying , shrinkage and thermal movements during and after the hardening period may also cause cracks in concrete members.

The temperature difference within concrete structure result in differential volume change, when the tensile strain due to differential volume change exceeds its tensile strain capacity of concrete, it will crack.

2-Factors are affecting the width of cracks

There are three factors which are affecting on the width of cracks which it can be summarized as following:

1- Connection of concrete with reinforcement of steel.

To increase the connection between steel bars and the surrounding concrete layers, therefore ACI code recommended anchorage in steel specially in end of bars at beams and girders at tension zone and it specified limits for the length of anchorage with respects to the angle of anchorage and diameters of bars, this anchorage give more safety for connection of reinforcement with surrounded concrete.

How ever, crack widths will be greater than for an otherwise identical beam in which good resistance to slip is provided along the length of the span. In general, beams with smooth round bars will display a relatively small number of rather wide cracks in service, while beams with good slip resistance ensured by proper surface deformations on the bars will show a large number of very fine, almost invisible cracks. Because of this improvement , reinforcing bars in current practice are always provided with surface deformation. (Arthurn H. Nilson, David Darwn(2004). Design of concrete structures)

2- Stress in reinforcement.

The designers are using the max. capacity of reinforced steel which is less than the calculated value according to the ductility curve; such as " elastic crodsed-section analysis" , according to the practice field when the steel is reached to the max. tensile it begin to be expanded and then caused cracking in concrete rounded the steel, therefore ACI code is limited the max. tensile for the steel due to the testing above of (o.6 fy), at item 10.6.4. i.e. reduced 40% from max. capacity of steel reinforcement.

3- Covering of concrete.

Covering is concerned with value of covering of concrete , and the distribution of steel at tensile zone is important in the relation with the width of cracks, so using the steel bars has small diameters is more effecting on the cracks and these bars are distributed in spacing according to the equation below: (ACI Code 2002)

S=[95000/fs] -2.5Cc.

Where Cc the net cover of concrete in tensile zone.
but not greater than 300(252/fs).
Calculated stress f_s (in ksi) in reinforcement at service load shall be computed as the un factored moment divided by the product of steel area and internal moment arm. It shall be permitted to take f_s as 60 percent of specified yield strength.
4- Thermal effects
The temperature difference within the concrete structure result as differential volume change in skeleton of concrete.
When the tensile strain due to differential volume change exceeds the tensile strain capacity of concrete, it will lead to cracks.
The liberation of heat of hydration of cement causes the internal temperature (heating) of concrete, which will be raised during the initial curing period, so that it is usually slightly warmer than its surroundings.
As the concrete cools it will try to contract. Any restrain on the free contraction during cooling will result in tensile stresses which proportional to the temperature change, coefficient of thermal expansion. When the exposed surface of freshly placed concrete are subjected to very rapid loss of moisture caused by low humidity, wind and high temperature of weather, the surface concrete shrinks. So the most of Iraqi south area are exposed to the high percent of humidity and the rise of temperature and these phenomena reflects their effects on the structures, so that cause more cracks in these buildings. So it is observed most of buildings in these area exposed to these phenomena which consider up normal for the modern buildings which are successful according the reasons mentioned in this section. Because of wide variation in using the different materials which differs in thermal extension because the weather ruling in these regions, so it must to evaluate these cracks and finding the reasonable solutions for it after studying the used materials that are close in thermal extension factors and planning an uniform engineering types for buildings with control on expansion joints for structures in all annexes and highways.
After field survey for buildings existed in AL-Muthanna governorate as sample for this search in southern areas, it is observed that most buildings in 90% expose for circumferences which are mentioned in point (4) above; also these phenomena happen in building under and after implantation recently and also for old, that what explained it evaluation forms.

3-Field evaluation of cracks

The procedure of evaluation was by prepare a papers consist of tables have some question about the cause of creation such these cracks in building, as because the deflection, expansion or thermal action, According to the field observation for cracks in buildings in south areas. It was observed three types of cracks as following: see Fig (1)
1- Cracks in concrete members comes from the thermal process as result of expansion and shrinkage because the high temperature in these areas (as shown in fig.1), this type were observed in most parts of buildings, and these cracks are famous in south area of Iraq and naturally existed in these areas because it appears

as result of a high temperature especially in summer season which the temperature reaches to 50 C^{o} and that leads to loss the water in mixture rapidly. This rapid losing of water makes the concrete is hardening quickly then caused the cracks.

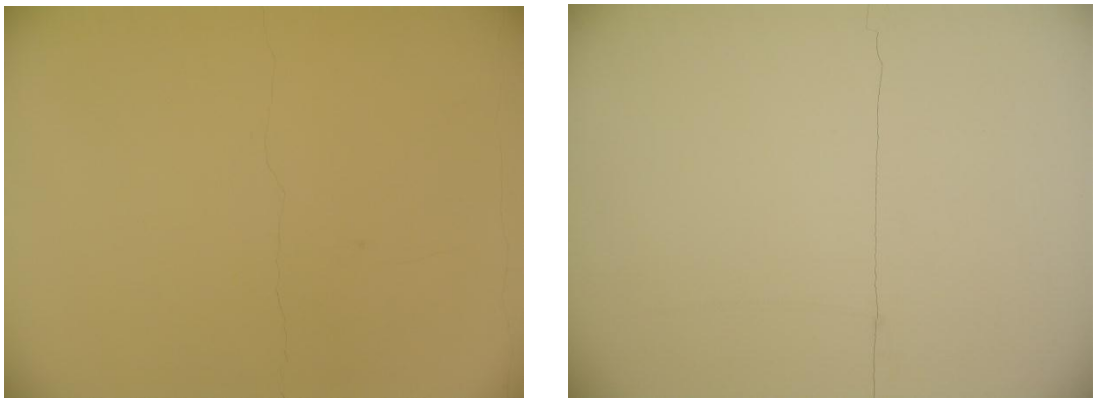

Fig (1) shows the cracks according thermal process

2- the cracks from the deflection due to service loads after implementation are dangerous and are found in the buildings which suffers from defect in design of concrete members or settlement in foundation because lack of compacting the soil under the foundation, or may that ascribed to bad implementation for these building; these cracks cause to deformity in structural parts as drop the plastering in ceiling or walls and swelling in floor and tearing out the flags. So it is better for the designer to estimate the applied load (dead and live loads) accurately and depending on these loads is specified the depth and reinforcement for concrete members, most of deflections comes from the little depth for the structural members especially for beams and girders. In addition, it should to avoid the deferential settlement by connecting the spread footings by strip beams or using mat foundation in weak soil because most of soils in south areas have low bearing capacity and motion of under ground water that affected on stability of soil and therefore on stability of foundation. Fig (2), (3) shows the crack in some building in south area because the deflection and settlement.

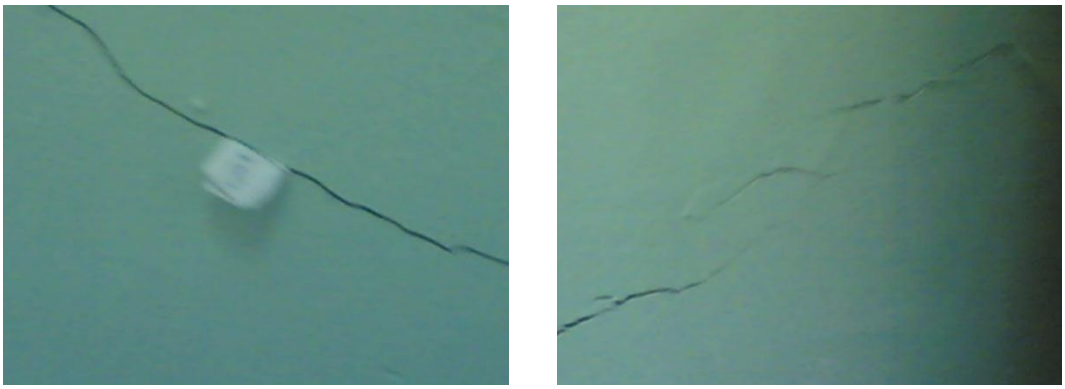

Fig (2) shows the cracks because the deflection

Fig (3) shows the cracks because the settlement

3- Cracks in vertical members as walls because the designer or implementer usually neglect the expansion joints especially for members exposed to the sun which are expanded and contracted continually, this process because nonexistence the expansion joint causes appearance cracks vertically leaded to drop the plastering from walls.

There are also type of cracks resulted from difference of expansion coefficients for the materials, this phenomena is noticed in walls which include inside it concrete columns or the building constructed of columns and after are divided by bricks walls, the expansion coefficient for concrete is greater than for bricks, so that causes freeing the cohesive between the columns and walls lead to appearance the cracks in walls, it is possible to avoid this process by fix mesh vertically in contact area between the wall and columns before plastering, that will keep the plaster as one mass and don't affect from the expansion and contraction for the materials.

4-Conclusion

From field survey for samples for the buildings which were implemented in Al Muthanna governorate, and for different area and stories; it were take same behavior related with cracks resulted of high change temperatures in seasons and between light and night which didn't put for it the designer engineer priority within the design stage. This phenomena where it's rate arrive 80 to 85% than the cracks resulted from other cases, so of this field observation it was concluded the following:

1- The difference in temperature in one day are between 20-25 C^o and between the reasons 10-50 C^o. This difference is big to permits for the structural materials used in construction to are expanded and contracted and, therefore reflect on cracks in buildings.

2- The Americans specifications (ASTM) and British and others specified the allowed distances in buildings to fix expansion joints for expansion and contraction, but there are cases happen in consistency of cracks in contrast with limited in specifications that establishes that the region obligated specified mechanism in determination the expansion joints un limited in standard specification.

3- observance of choice the nonstructural materials, which are convergent in expansion coefficients for, overcoming on some of this phenomena.

4- Approach to select others finishing in buildings other than known to reflect the heat of the building and to bear the difference in temperature.

5- Arrangement the geometrical shapes for building where are formed form regulated or uniform shapes and are convergent in its connection and not complicated to keep the one skeleton when expanded or contracted.

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