MAJOR CAUSES OF CRACK IN BUILDINGS PROJECT ON THE WALLS AND FLOORS: IN CASE OF WOLAITA SODO TOWN IN PUBLIC BUILDINGS

Mohammed Sujayath Ali[1], Saol Toyebo Torgano[2], Adane Tadesse tumato[3], Esubalew Tariku Yenialem[4]

[1] *Assistant Professor, Department of construction Technology and Management, Wolaita Sodo university, SNNPR, Ethiopia*
[2]*Lecturer, Department of construction Technology and Management, Wolaita Sodo university, SNNPR, Ethiopia*
[3] *Lecturer, Department of civil engineering, Wolaita Sodo university, SNNPR, Ethiopia*
[4] *Lecturer, Department of civil engineering, Wolaita Sodo university, SNNPR, Ethiopia*

ABSTRACT

The main purpose of this study was to assess the major cause of cracks in buildings on the walls and floors in case of Wolaita Sodo town in public buildings. To achieve this study, the qualitative research approach was employed. Purposive sampling technique was used because serious cracking problems were only appeared on the selected public building structure. These are wolaita sodo Administration building,Wolaita sodo university ottona Referral hospital and Wolaita sodo polytechnic college. The research selected these sites purposively because they have cracks in their walls and floors. The major data collection instruments employed for the study was observation. During the data collection process, the research used a digital camera to take the pictures of cracks observed in the buildings. Then the data collected were described in words being supported by photographs. The findings of the study revealed that the most predominant types of the cracks observed in these three buildings were dormant. The findings of the study also revealed that the cracks observed were diagonal, horizontal, and Randoms. Most of the cracks were occurred due to human faults. Hence, a continuous inspection during building project construction, and supplying adequate and necessary materials and allocation of adequate finance were recommended.

Key words: *Cracks in building, public buildings*

1.INTRODUCTION

Building defect is one of the major components of building problems that significantly needed attention. when a building fails to maintain as it should, we must immediately seek for the deterioration. The building defect occurs to either the new building or the old building, (David, 2010).

The problem of cracking in building was became a difficult puzzle for engineers now a days-cracking was an avoidable response of any structure while designers were tried to eliminate many of the case of cracking. Many design tolerances the other factors. A crack was an incomplete separation of concrete into two or more parts produced by breaking or furcating (Plama, 2015).

Occurrence of various crack patterns in the building during construction, after completion when it was subjected to super imposed load or during service life, it was a common phenomenon. A building develops crack whenever the stress in the components exceeds its strength. Stress in the building component could be caused by externally applied forces such as dead, live, wind or seismic load, foundation, (CAMTECH,2004).

Cracks were commonly found on and in structure and were usually undesirable feature naturally occurring due to age, workmanship, and other methods and environmental causes. Cracks were signs of structural movements designed after construction. Such movements occur all the time, usually its magnitude is so small that it possesses

unnoticed, (Richerd son,1996). cracks may of uniform or width through art or may be narrow at one end gradually widening at the other.

Crack may be straight, frothed, horizontal or diagonal. Cracks may be of surface or may extend to more than one layer of materials. Cracks due to different, causes have varying characteristics and by the careful observations of these characteristics, one can diagnose the causes of cracking for adopting the appropriate remedied measures. Having this into consideration, this study assesses the major causes of cracks focus on walls and floors in Wolaita Zone public project.

1.1 Statement of The Problem

It was the nature of many construction materials to crack as they age and as they expand and contract, particularly with exposure to moisture and the get wet and dry out alternately, there were cracks in common areas such exterior walls, interior walls and to corners of doors and window and ceilings causal, in the middle, (Nadin,2013)

According to Rodger (2001) crack was an evidence of graded deterioration and damage to the structure of buildings. Cracks was of little consequence and it was established as static, simple repair by filing or re-pointing as all that is required.

However, regarding the major causes of cracks in building focus in floor and walls has not been studied well. Hence, it seems important to conduct research to fill the gap. Therefore, this study attempted to identify the major cases of cracks in buildings project on walls and floors in case of Wolaita Sodo town public project.

1.2 Objectives of the study

1.2.1 General Objective

General objective of this study was to assess the major causes of cracks in buildings project on walls and floors in case of Wolaita Sodo town public building project.

1.2.2 Specific Objective

Specific objectives of this study were:

- To decide the significance of the cracks in walls and floors of public buildings.
- To identify the movement of the cracks in walls and floors of public buildings
- To describe the direct and indirect causes of cracks walls and floors of public buildings.

1.3 Significance of the Study

This study was believed to have paramount importance in terms of describing the common types of cracks in walls and floors of Wolaita Sodo town public buildings and identifying the major causes of cracks in walls and floors.

2. LITERATURE REVIEW

2.1 Construction Cracks

Construction usually cracks refers to any deficiency in the performing or turning the design, planning, supervision, inspection, construction or observation of construction to any new home or building in a reasonably workmanlike manner and / or the structure fails to perform in the manner that is reasonably intended by buyer,(Josephson,1998).

2.2 Cracks in Buildings

Cracks were inevitable in virtually all types of construction because of the kind of material we used, the ways in which we used or misuse them and the service conditions that our building experience. cracks in buildings were of common occurrence. A building component develops cracks whenever stress in components exceeds in its strength, (Kunel, 2014).

2.3 Types of Cracks in Building Unit

2.3.1 Structural Cracks

Structural cracks occur due to incorrect design, faulty construction, were overloading and these may endanger the safety themes of a building e.g. extensive cracking of a RCC beam, (CAMTECH,2004).Hell,(2010) reported that

structural cracks occur when the incorrect design, faulty construction or overloading and these may endanger the safety of amending.
Structural cracks mean any defects in a structural element of a building the that is attributable to defective design, defective or fairly faulty workmanship, or defective material and sometimes any combinations of these, (Per-Crik,1998). Building structure include earth repairing walls columns, beams and flat slabs structure defect can be categorized and cracks in foundation (substructure), cracks in floor or slabs (super structure) and cracks in vends (superstructure).

2.3.2 Non-structure Cracks
These were due to internal forces developed in materials due to moisture variation temperature variations, crazing effects of gap, liquids etc, (Plame, 2015). Non-structure cracks mostly due to internally induced strangles in building materials and do not endanger safety of a building but may look unsightly, or may create on impression of faulty work or may give affecting of insatiably, (CAMTECH, 2004).

2.4 Major Causes of Cracks in Building unit

2.4.1 Elastic Deformation
It occurs when a material strains under stress. When two materials changing different properties /build together under the effects of loads then different shear stress in these materials create cracks of the future. Dead and live loads and the major causes of elastic deformation in any structural components of a building, (Nadin, 2013).

2.4.2 Moisture changes and Variation
As a general rule, most of the building materials having pores in the mortar, burnt clay bricks, some stones, timber etc. expand on absorbing moisture and shrink on drying. these movements are reversible, that is cyclic in nature and is caused by increase or decrease in the inner-pore pressure with moisture changes, extent of movement depending on molecular structure and porosity of a materials, (Kunal,2014).
Building materials majority have pores in their burnt clay bricks, mortar, some stores etc. these materials expand on absorbing moisture and contract or shrink on drying. These movements were cyclic in nature and were cased due increase or decrease in the pore water pressure, execute of tube movements also depends on molecular structure a material. (More, S. 2017).
A review on causes, preventive, repair and maintenance of cracks in building (residential) and commercial). international research journal of Engineering and Technology (IRJET). volume, 04 issue ll. Airoli, Navi mumber, India).

2.4.3 Movement Due to Creep
Some building items, such as concrete, brickwork, and timber, when subjected to sustained loads not only undergo instantaneous elastic deformation, but also exhibit a gradual and slow time-dependent deformation known as creep plastic strain (institution code of practice for plain and reinforced concrete 2000).

2.4.4 Cracking Due to Vegetation
Existence of vegetation, such as fast-growing trees in the vicinity of compound walls can sometimes cause cracks in walls due to expansive action of roots growing under the foundation. Roofs of a trees generally spread horizontally on all sides of to the extent of height of the tree above the ground and when trees are located close to a wall, these should always be viewed with suspicion, (Kunal,2014).

2.4.5 Defective plaster rendering
Mostly the defective plaster rendering occurs on the external walls, column and ceiling. Defective rendering is normally caused by biological attacks arising from penetrating rain, evaporation, condensation, air pollution, dehydration and thermal stress. The mould or harmful growth, insect, animals, and traffic vibration also will contribution causes of defective plaster rendering. Prior to being decomposed and broken apart, rendering may crack due to either shrinkage or movement in the substrate. (A Ghafar Ahmad) (2014).

.**2.4.6 Evaluating Cracks in Buildings project**
Roberts, C. C (2012). "Evaluating Cracks in Buildings". Retrieved from http. The nature of cracks according to can be classified as active crack which is still in progress, that is, the crack is still developing, and dormant cracks,

in which the development is not observed during a considerable period of time, and then this crack is known as dormant crack.

2.4.7 Shrinkage

Most of the building materials expand when they absorb moisture from atmosphere and shrink when they and dry Shrinkage can be of plastic or dry. The factors causing Shrinkage in cement concrete and cement mortar and their preventions were as following.

A. Excessive water, the quantity of water used in the mortar mix can cause shrinkage vibrated concrete has less quantity of water and lesson Shrinkage that mutually compacted concrete.

B. Quality of cement, as a general rule, the rider the mix was, the greater the shrinkage/durable wire, (Per.Crik, 1998)

3.Data Analysis or collective and Discussion

3.1 Brief description of the under-study buildings.

3.1.1 Wolaita Zone Administration building.

Wolaita Zone Administration office building has one blocks, and building has four floors. The floors basement is named as FB, the ground floor was named (F0), the second floor named (F2), the first floor named(F1), the third floor named(F3) and the fourth floor named (F4). the structural frame members consist of 25 beams, 35 columns, and totally, it consists of 15 members. Aluminium roofing sheets are used to cover the roof and contains a roof gutter for proper drainage. each floor has a retaining wall that links the basement floor to the ground floor. Both active and dormant cracks have been appeared on the building but the most predominant types of cracks are dormant.

During the observation, a diagonal crack was seen on the front wall of the building near to the gait (entrance) of the building. This crack was observed near to the entrance of the building. In addition, a diagonal crack was also observed near to the window of the building. A diagonal crack to the window was seen in F1, R3, W3 and F2-R2 and W2 The causes of the cracks were due to both plastic and to drying shrinkage. The plastic shrinkage is caused due to water ratio is so much. Too much water will take up space, causing the solid ingredients of the mix to separate. The drying shrinkage were caused due to the contracting of a hardened concrete mixture which resulted due to the loss of capillary.

The drying shrinkage cracks were occurred due to the properties and proportions of components, as well as mixing manner, in addition, it can be resulted because of the amount of moisture; while curing dry environment. (as seen externally) (As observed Externally) (see F4,1) The crack is wider at the top and become narrow as it travels downward. The cause of the crack may appear when it is built on shrinkage clay soil like block cotton soil and shallow foundation.

Figure 1. Picture of Diagonal cracks on wall and internee defect ceramic floor

Another types of cracks that was observed at wolaita Sodo Administrative office building was vertical cracks on the floor. The floor where this vertical crack appear was F1-R3 and F1-R2. The cracks may appear due to a combination of poorly foundation on footing, blasting or on adjacent building (as displayed in Fig,3.)

Figure 2. Picture of Diagonal cracks on wall and floor

Moreover, random cracks were observed on floors in the internal building. The main cause to this cracks may be due to moisture movement of shrinkage soil (block cotton soil) when the foundation is shallow. The building blocks that was seen in such crack was F1-R2 and F1-R3.

Figure 4. Picture of random cracks wall and floor

NO	Locations	View	Nature	Direction	Position	With(mm)	Depth
1	F0-R3-W3	External	dormant	horizontal	left side	1mm	0.80 inch
2	F1-R3-W2	External	dormant	vertical	Right side	1mm	0.65 inch
3	F0-R3-W3	External	dormant	horizontal	Rare	2mm	0.95 inch

4	F2-R2-W2	External	dormant	horizontal	left side	200mm	1.5inch
5	F2-R2-W4	Internal	dormant	diagonal	Right side	100mm	2.5 inch

Table 1 observed cracks on the walls and floors of Wolaita Sodo Administrative office Building

3.2 Wolaita sodo university Ottona Referral Hospital

Wolaita sodo University Teaching and referral ottona Hospital has three blocks, and each block have two and three floors. The basement the floors were coded as FB; the ground floor (named F0), the second floor (named F2), the first floor (named F1). (As shown in platelet). The structural frame members of the building consist totally 20, 3 and 45 beams, 65 columns, respectively. The building has a roof with gutter for proper drainages and was covered with aluminium roofing sheets. The retaining wall of the roof links the basement floor to the ground floor. The most dominantly observed types of cracks in the building was active cracks. which is constantly changing in some way either in terms of its length, width or depth over time.

Figure 5. Picture of Active Vertical cracks wall and Horizontal crack floor

The main parts of the building which were affected by active cracks were F0-B, -R2-w2, F1-A-R3-w2, the main causes to the active cracks. The main causes to the active cracks of the building was due to damage on /in reinforced concrete structures. It was observed under in-service conditions. The width of the crack on the floor was medium (1mm to 2mm).

Figure 6. Picture of Active Vertical cracks wall and Horizontal crack floor

The crack has a continuous movement that moves in one direction at a uniform speed and is generated by the application of a length of amount of stress on the material, usually more than the designed stress holding capacity of the material. It has one millimetre wide.
Another type of cracks (as displayed in plate 4) occurred at wall F0, A-R3-w3(as seen external view). due to the earth under the house is not strong enough to support the weight of the structure, so the structure starts to more do

Figure 7. Picture of Random cracks wall and Horizontal crack floor

During the observation, there was also seen a horizontal crack on the wall due to excessive unbalanced soil pressure and it has seen near the canter of the wall and nagger to the top of the wall.In addition to the other types of cracks which was seen a warring the observation was random crack. The cause of the random cracks may be settlement foundation crack probably occurred during the initial flooring settlement. it was observed in the wall F1, -R-2-w3 and F2-R2-w1. During the observation, wide diagonal cracks were seen in the buildings of Ottona referral hospital. It was occurred due to settlement of foundation, if true is opposability of further movement, it was characterized by

tapering and were wider at the top, and occurred due to foundation settlement. The floors and walls affected by this types of cracks were-F0, R1-w4, F1, R3-w4 and F2, R2-w4. The movement of the wall was diagonal.

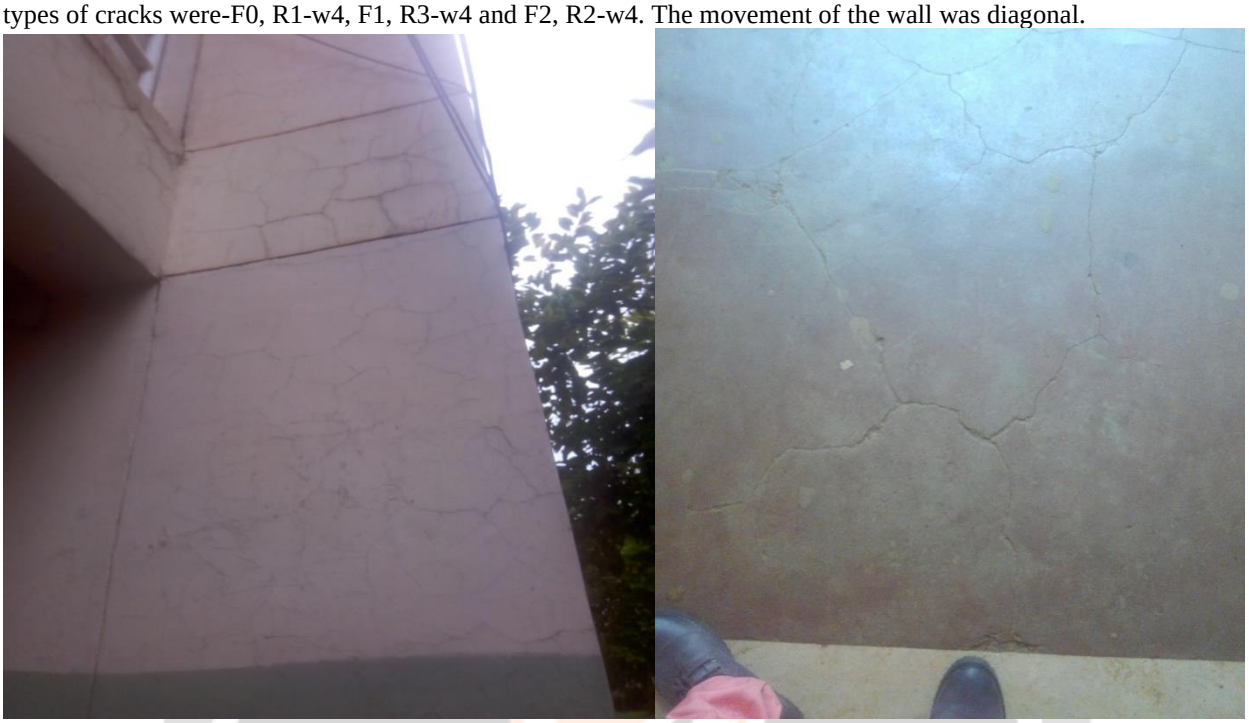


Figure 8. Picture of Random cracks wall and Random crack floor

NO	Locations	View	Nature	Direction	Position	With(mm)	Depth
1	F0-R3-W3	External	dormant	horizontal	left side	1mm	0.80 inch
2	F1-R3-W2	External	dormant	vertical	Right side	1mm	0.65 inch
3	F0-R3-W3	External	dormant	horizontal	Rare	2mm	0.95 inch
4	F2-R2-W2	External	dormant	horizontal	left side	200mm	1.5inch
5	F2-R2-W4	Internal	dormant	diagonal	Right side	100mm	2.5 inch

Table 2; -observed cracks on the walls and floors of Wolaita Sodo University Teaching and Referral Hospital building.

3.3 Wolaita Sodo Poly Technic College

Wolaita Sodo Poly Technical College building which has not been completed three rooms with three floors. These floors are the basement floor (named FB). The three floors of the building named as (F0) the ground floor, F1(the first floor), and F2(the second floor (see plate 1). The total number of the walls, beams and columns of the walls were 8, 2 and 10 respectively. For the proper drainage, the roof was built with gutter and roofing sheets used to cover the roof. The ground floor and the basement floor of the building was fixed with retaining walls. The dirty surface of the cracks along with nature of the cracks were observed dormant.

Figure 10. Picture of Active Diagonal Crack for walls and Random Crack for floor

During the observation, it was seen that the major cracks on the floors and walls of the building were surface cracks. Hence, it is a shrinkage crack. The shrinkage cracks observed could occur due to the excessive use of cement to sand, and also not gluing adequate covering services. In addition, drying shrinkage may occur due to the contracting of a hardened concrete mixture due to the loose of capillary water. This crack was seen F1-R2-w4, F2-R2-w5 and F2-R4-w2.

Figure 11. Picture of Active Diagonal Crack for walls and Horizontal Crack for floor

Regarding the cracks observed on the walls and floors of the building. It was observed that most observed walls and floor cracks were horizontal cracks. Horizontal cracks were observed in student learning classroom (F0)- students learning rooms near to the construction department -w1, it was also seen in students learning classroom (F1)-R2-w2 and wall a student's GITIZED learning classroom blocks 4 -room2 w2.The observed horizontal wall cracks were 0.73 mm span width. It was also observed that the long spanned been (7.22 x6mm=7.3m). It may be caused by excessive unbalanced soil pressure and occurred near the centres of the wall and nearer to the top of the wall.

Figure 13. Picture of Active Vertical Crack for walls and Horizontal Crack for floor

Based on the external observation, the types of cracks at wall F0-4-R3-w3. The horizontal cracks which were observed around the walls were due to the very large room spans.

In addition to the horizontal cracks that were occurred due to the very large room spans, excessive unbalanced soil pressure, the third causes to the occurrence of cracks on the walls on blocks 4 floor 1, block 4 floor 2 and block 4 floor 3 in the GITIZED students learning room was due to foundation settlement. The possible causes to this crack were shrinkage of concrete or mortar. Land soil settlement, soil pressure and construction defect.

Figure 13. Picture of Active Vertical, Horizontal Crack for walls and Random Crack for floor

NO	Locations	View	Nature	Direction	Position	With(mm)	Depth
1	F1-R2-W4	External	dormant	horizontal	Left side	11mm	0.65 inch
2	F1-R3-W5	External	dormant	horizontal	front	120mm	0.75 inch
3	F2-R4-W2	External	dormant	Vertical	rare	250mm	1.75 inch
4	F2-R4-W3	External	dormant	horizontal	Left side	50mm	1 inch
5	F3-R1-W4	internal	dormant	diagonal	Right side	100mm	1.35 inch
6	F4-R2-W1	internal	dormant	random	rare	85mm	0.95 inch

Table 1; -observed cracks on the walls and floors of Wolaita Sodo poly Technical College building.

Another crack types that were observed on the building walls was stepped cracks in bricks work which follows the mortar lines due to structural defect or as a result of building foundation weakness such types of cracks were observed (F0-class -room W1,W2), F1(classroom-W4,W3) as well as in classroom F2 (W1 and W2)(see plate....., and .....). The significance of the crack was moderated. As seen during the observation, from the external walls of the building was horizontal crack at the junction of roof slab and masonry wall support this crack was observed on wall F0-R2-W3(as seen externally). This crack was also observed on wall F2-R4-W3. Another type of cracks observed wall cracks due to loads applied above the opening. It was seen above first floor (F1) lintels where the roofs purloin have been installed directly above the window openings. The load imposed is too great for the lintel to cope with and the down ward pressure causing the cracking. These cracks observed in F1-R4-W2, and F2-R1-W4.

4.CONCLUSIONS

Based on the results obtained through careful observation of the cracks on walls and floors of public buildings in Wolaita Sodo town, the following conclusions were drawn. Most of the observed cracks were horizontal, stepped cracks and dormant except the active cracks while were observed in Ottona referral hospital and Sodo poly technical college. Most of the cracks that were observed on walls and floors in building at the three study sites (wolaita sodo university teaching Ottona referral hospital, Wolaita Sodo Zone Administrative Office Building and Wolaita Sodo Polytechnical College Building) were the results of improper construction practices are due to ignorance, carelessness, greed or negligence, problems occurred due to incorrect structural design, detailing, and specifications, building materials with pores in their structure in the form of inter-molecular space expand on absorbing moisture and shrink on drying, As deterioration process in concrete begins with penetration of various aggressive agents. it dictates the ability of concrete to withstand weathering action, chemical attack, or any process of deterioration, Creep increases with increase in water and cement content, water cement ratio and temperature. As the results observed, the **remedial measures for these defects is** all three building structures need to be maintained after a lapse of certain period from its construction completion.

REFERANCES

1.CAMTEH (2014). Crack in Building. (Causes and Prevention). Government of India Ministry of Railways. Meharejpur, perguollow,41043.

2.David, A (2010). Human Error in the management of Building, projects Construction management and Economics, Volume 16,May,pp339,349.

Josephson, (1998) Cracking in Low-rise Buildings some Technology for Diagnosing the Cause. Signification Structural Faulty and Repair Conference a , (2011). Engineering Technology pup, Edinberg

3.Killemsetty,N.(2014) Study on Control of Cracks in a Structure Through Visual Identification and Inspection. University of Massachuteus, Boston.

4.Kunel,K , JOSR-journal Mechanical and Civil Engineering.(JOSR JMCE) 2004. Study on Control of Cracks in a .Structure Through Vital Idea to Factor and Inspection.

5.Nadin, N.(2013). General Building Defects: Cause, Systemisation and Remedial Work. European Journal of Technology and Design.vol.3,No 1. Malasyia.

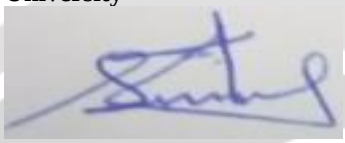
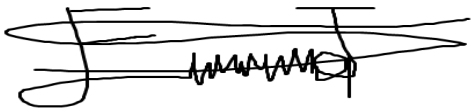
6.Nana, p-(2015). Study on Causes of Cracks and Its Preventive Measures in Concrete Structure. Hed. Goril. Department of Career Point. University ,Kota

7.Per-Crik, I. (1998) Causes of Defects in Construction. A Study of Seven Buildings Project in Buildings. Department of Management of Construction and Facilities, Chalmers University of Technology, Gothembuing, Sweden.

8.Plame, (2015). A crack was an incomplete separation of concrete into two or more parts produced by breaking or furcating

9.Rodger, (2011) The significance of cracks in Low Risk Bridges. Charter Civil and Structural Engineer and Surveyor

10. Richerd, Son, (1996). Structural Movement: was it Really a Problem 31 Retrieved from http://www.Building Construction.

	Mohammed Sujayath Ali **Lecturer in Wolaita Sodo University** Wolaita Sodo University
	**Saol Toyebo Torgano Lecturer in Wolaita Sodo University**  Graduated BSC in Construction Technology and Management from Addis-Ababa university and Msc in Geotechnical Engineering from Jimma university, Jimma institute of technology. Wolaita Sodo University
	Adane Tadesse Tumato: Lecturer at Wolaita sodo University, Ethiopia BSc degree in civil engineering from Arba minch university MSc degree in road and transport engineering from Hawassa university
	**Esubalew Tariku Yenialem Lecturer in Wolaita Sodo University**  Graduated BSC in civil engineering from Debre-Markos university and Msc in geotechnical engineering from Arba-Minch university, Arba-Minch university institute of technology. *Wolaita sodo university*