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The Comparison of Deflection And Strain Values Between EverStressFE Software Analysis And Multilayer Laboratory Test Results

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Abstract: -EverStressFEcan be used as comparison ofmultilayertest result in laboratory, while the value of input parameters needed are the values of deep, modulus of elasticity and Poisson ratio for each layers. The results of EverStressFE analysis for multilayer soil-rigid are vertical deflection 0.5 mm, vertical microstrain (εz) ± 0 s/d 200 on deepness 150 mm, and for multilayer soil-rigid-asphalt results vertical deflection (Uz) ± 0.64 mm on the surface and± 0.4 mm on the deepness of 50 mm, and vertical microstrain vertical (εz) ± -6400 s/d -7200 on the surface, ± -4800 s/d -5600 on the deepness of 150 mm.As the result of laboratory test soil-rigid is vertical deflection each point 1.535 mm, 1.535 mm, 4.505 mm, 2.45 mm, 4.19 mm, and 3.61 mm, and microstrain C1 to C4 0.36, -37.68, 44.44, 43.48, and the resultsof testMultilayer soil-rigid-asphaltare verticaldeflection each point 1.576 mm, 0.075 mm, 3.7 mm, 1.985 mm, 2.48 mm, 0.986 mm, and the value of asphalt course microstrain is 655.

Keyword: *-Modulus of elasticity, Poisson ratio, multilayer,microstrain,deflection*

I. INTRODUCTION

The roads are very important for land transportation infrastructure especially for distribution of goods and services, and to support the economic growth. The safety, comfortable, robust and economic roads will make people easier in their movement. There are three types of pavement construction known today, such as flexible pavement, rigid pavement, and the combinations that known as composite pavement.
From the information the writers have, to determine the loads effect to the pavement construction of multilayer can be simulated using computer software i.e. EverStressFE.

II. LITERATURE REVIEW

A pavement construction is a construction of pavement put over the subgrade to serves the traffic loads.
Based on the bonding materials, pavement construction can be divided to:
a. Flexible Pavement
b. Rigid Pavement
c. Composite Pavement

Modulus of elasticity, often called as Young Modulusis a comparison between stress axial strain in an elastic deformation, so that modulus of elasticity shows the trend to deform and be back to the original form when under loads (SNI 2826-2008). This isshown by equation:

$$E = \frac{\sigma}{\varepsilon} \qquad 1$$

while E = modulus of elasticity, σ = stress and ε = strain

Poisson Ratio (μ) is the values of comparison between horizontal strain (lateral strain) and vertical strain (axial strain) caused by loads thatare parallel to axis and axial strain (Yoder, E.Y. and M.W Witczak.1975). This is shown by equation:

$$\mu = \frac{\varepsilon_h}{\varepsilon_v} \qquad 2$$

While: μ = Poisson ratio, ε_h = lateral strain, ε_v = axial strain

EverStressFE version 1.0 (available for download at www.civil.umaine.edu/everstressfe) is a user-friendly three-dimensional (3D) finite-element based software package for the analysis of asphalt pavement systems subjected to various wheel/axle load combinations.
EverStressFE is useful for both flexible pavement researchers and designers who must perform complex mechanics-based analyses of flexible asphalt pavement systems.

Some of the major features of EverStressFE are summarized below

- **Intuitive and user-friendly graphical user interface**.
- **Ability to model systems with 1-4 layers**..
- **Modeling of multiple-wheel systems**
- **Batch analysis capabilities**.
- **Visualization of results**.

III. RESEARCH METHODS

Methods that are used in the tests are laboratory experiment and analysis using software EverStressFE. The steps are :

➢ Unconfined Compressive Strength Tests for Material Soil, Rigid, and Asphalt.

The purpose is to determine the value of modulus of elasticity and Poisson Ratioof each element. The processes of the tests are:

- Prepare the test instruments, such as: set Universal Testing Machine (UTM), Data Logger, Computer, LVDT cables, Strain Gauge, and bearing plate.
- Connect the data logger and computer that has been installed withsoftware Visual Log.
- Connect the LVDT cables to data logger
- Put the testing material briquettes on UTM, and put the bearing plate upon the briquettes.
- Install the LVDT cables around the briquettes as a sensor of deformation.
- Start the test, as the loads done mechanically by the UTM, and the value of deformation recorded on computer.

Figure 1. Universal Testing Machine

➢ Load test multilayer

Two types of specimens multilayer that has been done will get through the load test to find the values of deformation, stress, strain, and the capacity of maximum load that can be overhead by each specimens. The procedures of the test are:

- Install the 1x1 m box at the portal
- Embedding the strain gauge at the specimens

- Put the specimens to the box
- Install the sets of hydraulic pump to portal, then set the load cell.
- Install the LVDT cables to data logger, connect data logger to computer that has been installed of software Visual Log.
- Doing the test, as the loading using hydraulic pump that operated manually, and the results are recorded to the computer.

The type of asphalt that has been used in the test is asphalt gradation of 4%.

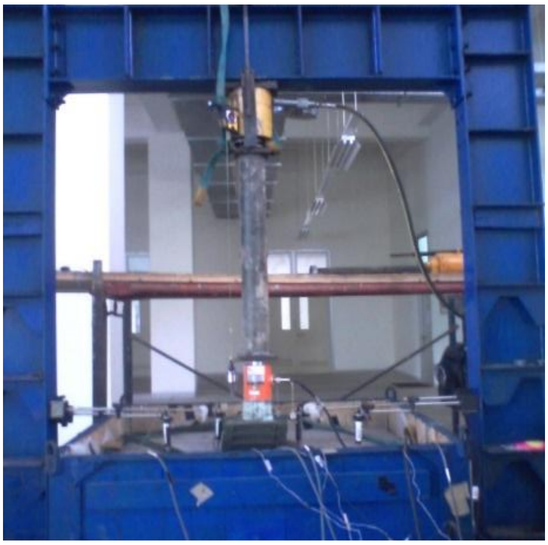


Figure 2. Portal and box

Figure 3. Specimen ofmultilayer- rigid

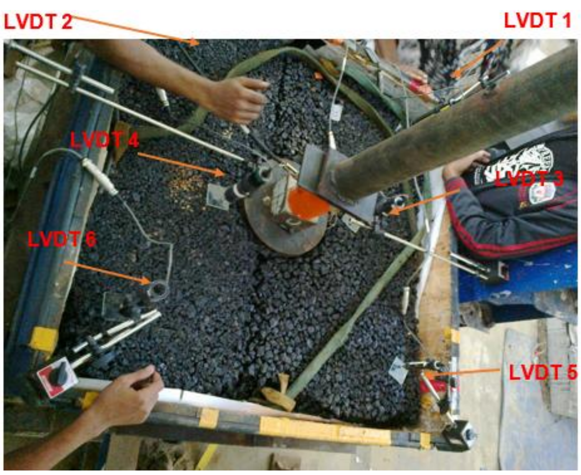


Figure 4. Specimen ofmultilayer rigid-aspal

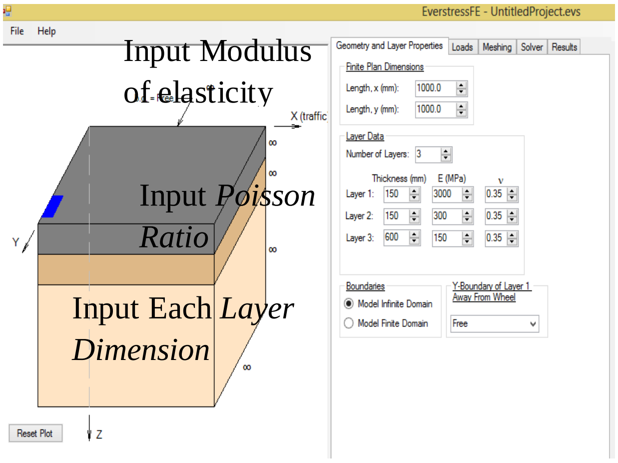
➢ Processing the test results

The processing of the result of Unconfined Compressive Strengthtest and load test multilayeris using software Microsoft Excel 2013, after copying the test results from software Visual Log.

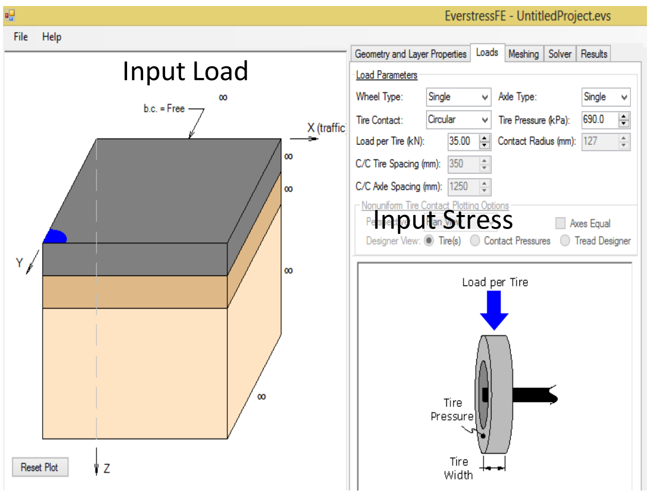
➢ Compare the result of Load Test Using Software EverstressFE

The result of data-processing of load test by program Microsoft Excel will be compared with the analysis result using software EverStressFE. The proceduresusing thesoftware are shown below :

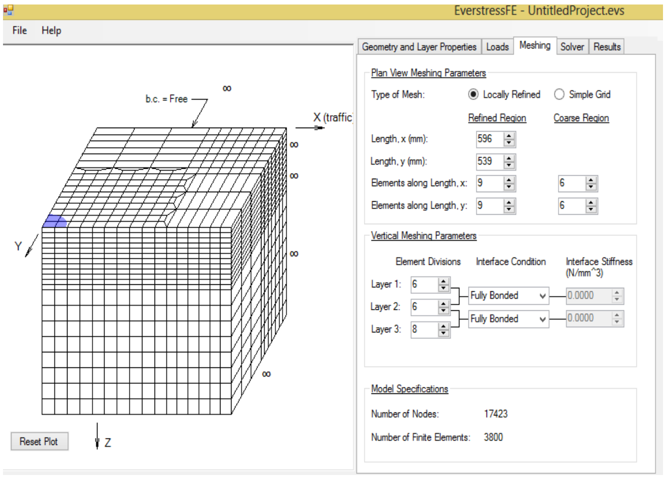
- Input the dimension value of eachlayer, and each value of modulus ofelasticity and Poisson Ratio.



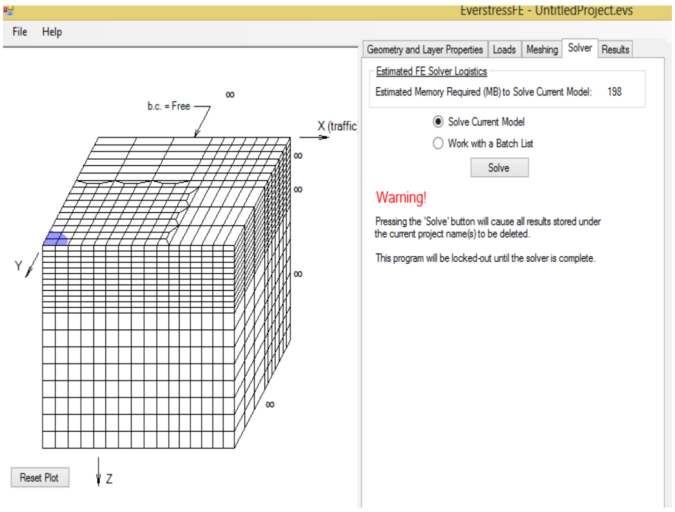
- Input the load value; according to the area of contact that is obtained from the area of bearing plate using (507 cm^2), the maximum load is 35,0 kN.



- For Tab **Meshing**, a change was not done



- After that on tab **Solver**, press **Solve**.



- It will show the graphics on tab **Results**.
- The graphics that are shown will be captured then compared with the result of data-processing load test **multilayer**.

IV. RESULTS AND DISCUSSION

1.1. Result of compressive strength of soils in laboratory
After doing the test, can be obtained the value of Modulus of Elasticity 11,91 MPa, and Poisson Ratio 0,0465.

1.2. Compressive strength test of rigid
The value of Modulus Elasticity obtainedis11617.35 MPa, and Poisson Ratio 0,22.

1.3. Compressive strength testing of asphalt
The maximum value of modulus elasticity obtained at the 4% content; is68.91 MPa and Poisson Ratio 0,374.

1.4. Load test for Multilayer Soil-Rigid

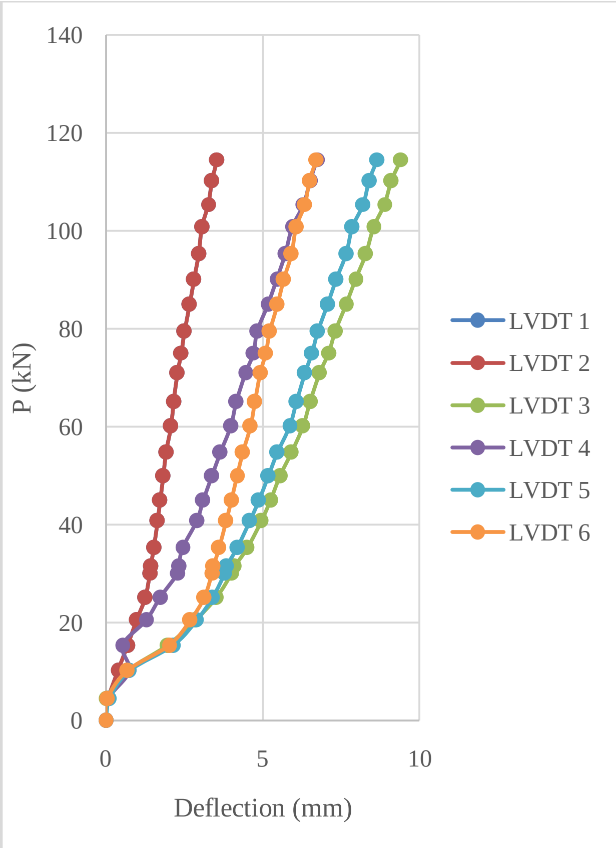


Figure5. Graphs of correlation between loads and deflection

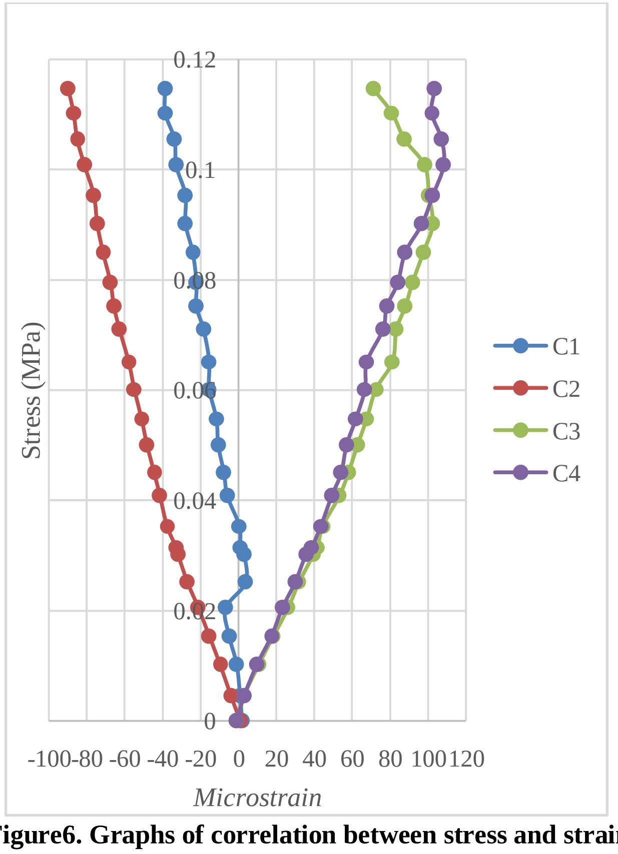


Figure6. Graphs of correlation between stress and strain

1.5. Testing MultilayerSoil-Rigid-Asphalt

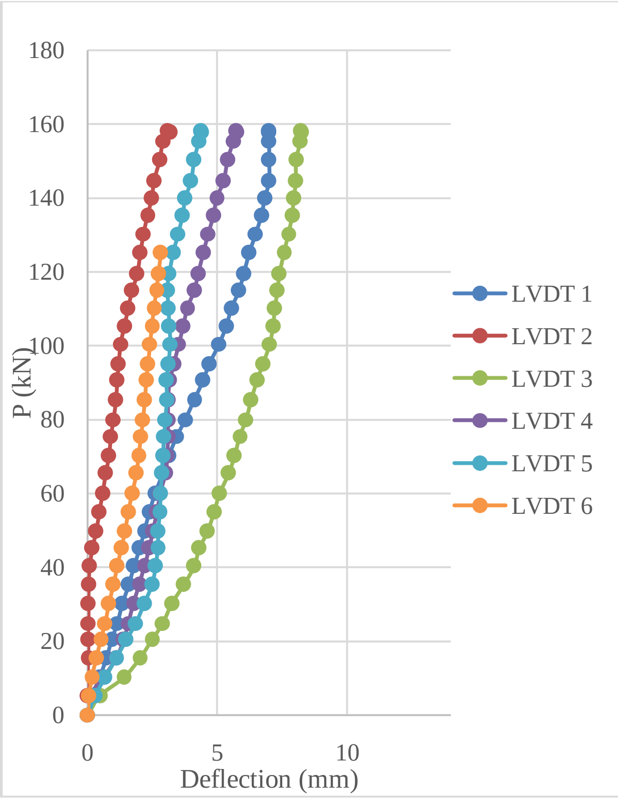


Figure7. Graphs of correlation between loads and deflection

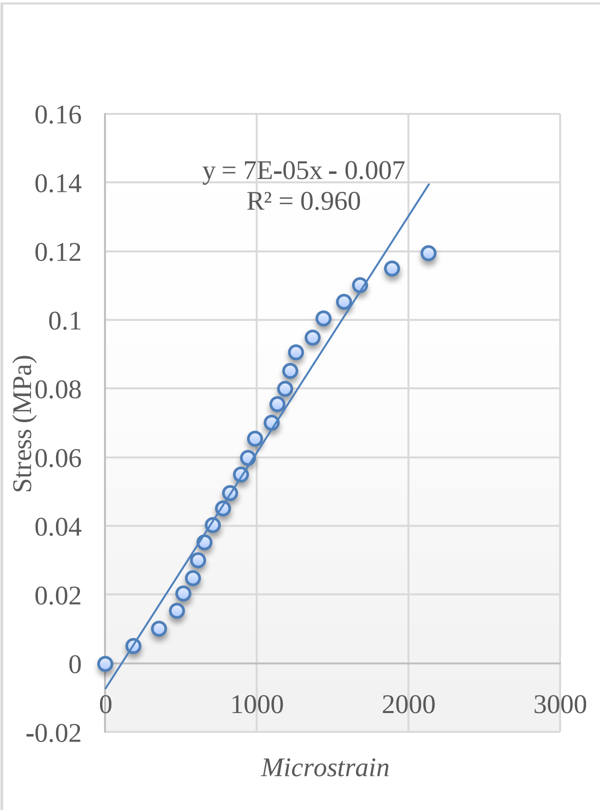


Figure8. Graphs of correlation between stress and strain of asphalt course

1.6. Analysis using Software EverStressFE

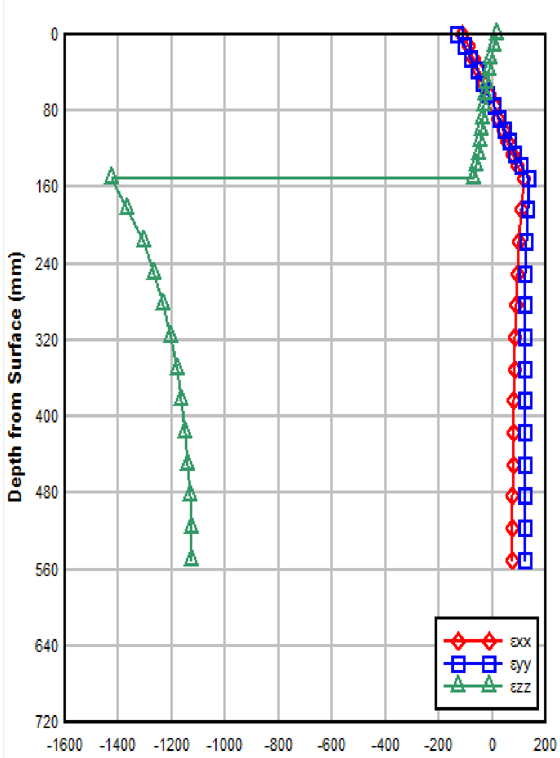


Figure9. Graphs of correlation between depth and strain formultilayer soil-rigid

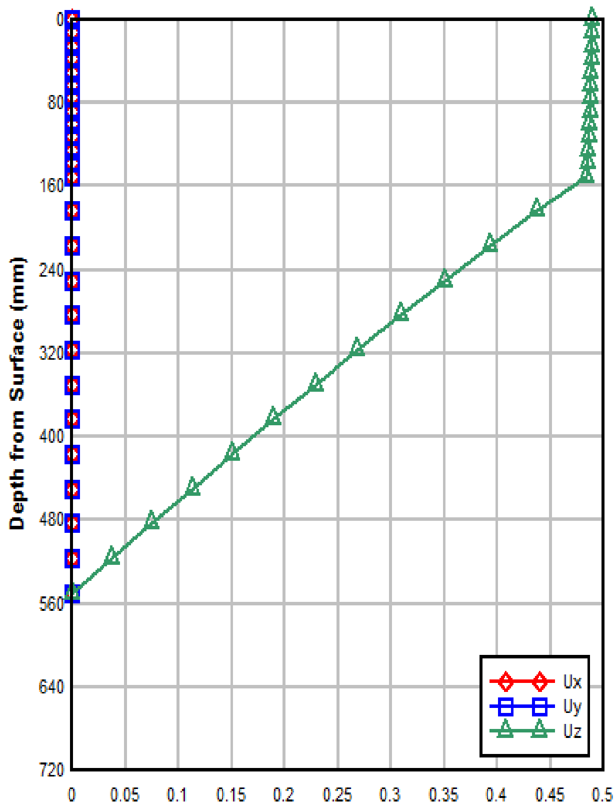


Figure10. Graphs of correlation between depth and deflection/displacement for multilayer soil-rigid

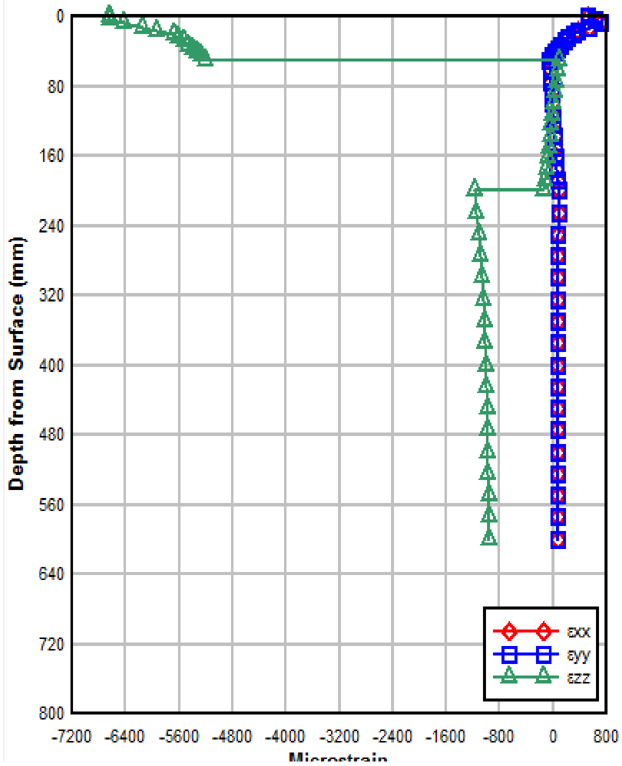


Figure11. Graphs of correlation between depth and strain for multilayer soil-rigid-asphalt

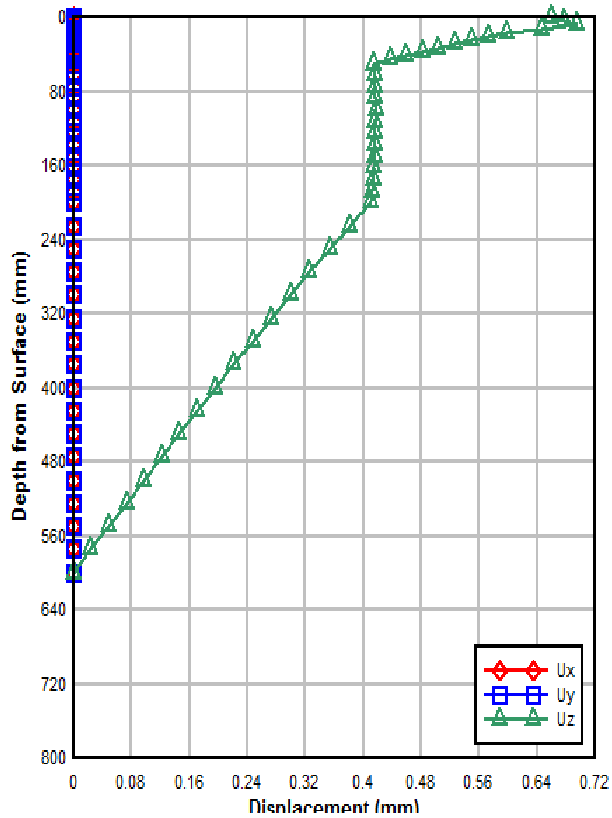


Figure12. Graphs of correlation between depth and deflection/displacement for multilayer soil-rigid-asphalt

V. CONCLUSION

a. The results of test MultilayerSoil-Rigid are : the values of deflection at the maximumload on LVDT 1 to LVDT 6 are 3.545 mm, 3.545 mm, 9.4 mm, 6.745 mm, 8.65 mm, and 6.705 mm.At the maximum stress results the microstrain C1 to C4 -38.65, -89.85, 71.21, 103.5. At the load 35 kN, the value of deflection onLVDT 1 to LVDT 6 are 1.535 mm, 1.535 mm, 4.505 mm, 2.45 mm, 4.19 mm, and 3.61 mm, while at value of stress 0.035 MPa generates the results of the microstrain C1 to C4 0.36, -37.68, 44.44, 43.48.

b. The results of test Multilayer Soil-Rigid-Asphalt are : the values of deflection at the maximum load on LVDT 1 to LVDT 6 are 6.98 mm, 3.2 mm, 8.25 mm, 5.75 mm, 4.38 mm, are 3.5 mm. At the maximum stress generates the result of the microstrain of asphalt course 2133.95. At the load 35 kN, the value of deflection on LVDT 1 to LVDT 6 are 1.576 mm, 0.075 mm, 3.7 mm, 1.985 mm, 2.48 mm, and 0.986 mm, while at value of stress 0.035 MPa generates the result of themicrostrain of asphalt course 655.

c. The analysis ofmultilayer soil-rigid using software EverStressFE shows at the load value of 35 kN results vertical deflection (Uz) 0.5 mm, and verticalmicrostrain(εz)$\pm$ 0 s/d 200 at the depth of 150 mm. Formultilayer soil-rigid-asphalt, the value ofvertical deflection (Uz) is $\pm$ 0.64 mm on the surface and$\pm$ 0.4 mm within the depth of 50 mm, and verticalmicrostrain(εz) $\pm$ -6400 s/d -7200 on the surface and$\pm$ -4800 s/d -5600 within the depth of 150 mm

d. The result of analysis using software EverStressFE isdifferent from the laboratory test result, which means the software cannot be used asa validation of that kind of model laboratory testing that has been done.

BIBLIOGRAPHY

[1] Alderon. A, John. B, John. O, John. R, 1997. "Open Graded Asphalt Design Guide" Australian Asphalt Pavement Association.
[2] Anas Aly, Mohamad. 2004. Teknologi Perkerasan Jalan Beton Semen, Yayasan pengembangan teknologi dan manajemen
[3] Cabrera J.G. and Hamzah M.O., (1996), 'Aggregate Grading Design for Porous Asphalt', In Performance and Durability of Bituminous Materials, E&FN Spon Publisher, London.
[4] Djumari. Sarwono, Djoko. 2009. PERENCANAAN GRADASI ASPAL PORUS MENGGUNAKAN MATERIAL LOKAL DENGAN METODE PEMAMPATAN KERING
[5] Hadihardaja, Joetata. 1997. REKAYASA JALAN RAYA, Penerbit GUNADARMA.
[6] Pedoman Bahan Konstruksi Bangunan dan Rekayasa Sipil Perancangan dan Pelaksanaan Campuran Aspal Porus, Kementerian Pekerjaan Umum.
[7] Saodang, Hamirhan. 2005. KONSTRUKSI JALAN RAYA PERANCANGAN PERKERASAN JALAN RAYA, Penerbit NOVA.
[8] Suryawan, Ari. 2009. Perkerasan Beton Semen Portland (Rigid Pavement), Beta Offset Yogyakarta.
[9] Yoder, E.Y. Witczak, M.W. 1975. Principles of Pavement Design. Wiley Interscience Publication.
[10] EverStressFE1.0 Software for 3D Finite-Element Analysis of Flexible Pavement Structures: Summary of Features and Capabilities. 2009

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