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TANZANIA STANDARD

Autoclaved Aerated concrete (AAC) - Specification

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TANZANIA BUREAU OF STANDARDS

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0 Foreword

The Tanzania Bureau of standards is the statutory national standards body for Tanzania, established under the act.No.3 of 1975, amended by act.No.2 of 2009.

This draft Tanzania Standard is being prepared by BCDC 2 Masonry Technical Committee under the supervision of the Building and Construction Divisional Standards committee (BCDC).

In the preparation of this draft Tanzania Standard assistance was derived from ASTM C1693 − 11 (Reapproved 2025) Standard Specification for Autoclaved Aerated Concrete (AAC). published by American Society for Testing and Materials (ASTM)

Autoclaved Aerated Concrete (AAC) is a lightweight cementitious building material characterized by a cellular structure containing a large proportion of uniformly distributed air voids. The material is produced from cementitious and siliceous raw materials, water and an aerating agent, followed by expansion, cutting and curing under high-pressure steam in an autoclave. The autoclaving process promotes the formation of stable calcium silicate hydrates, resulting in a lightweight material with controlled physical and mechanical properties.

AAC is used extensively in building construction in the form of masonry units for both load-bearing and non-load-bearing wall applications. Its low density, combined with adequate compressive strength, thermal insulation, fire resistance and sound insulation characteristics, makes it suitable for a range of construction applications. AAC masonry units may be used for external and internal walls, partitions, cavity walls and other forms of wall construction, subject to the structural and environmental requirements of the intended application.

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1 Scope

1.1 This specification covers autoclaved aerated concrete (AAC), a cementitious product based on calcium silicate hydrates in which low density is attained by the inclusion of an agent resulting in macroscopic voids, and in which curing is carried out using high-pressure steam.

1.2 The raw materials used in the production of autoclaved aerated concrete are Portland cement or blended cements, quartz sand, water, lime, gypsum or anhydrite, and an agent resulting in macroscopic voids. The quartz sand used as a raw material may be replaced by a siliceous fine aggregate other than sand, and usually is ground to a fine powder before use. Fly ash may be used as a sand replacement. The batched raw materials are mixed thoroughly together to form a slurry. The slurry is cast into steel molds. Due to the chemical reactions that take place within the slurry, the volume expands. After setting, and before hardening, the mass is machine cut into units of various sizes. The units then are steam-cured under pressure in autoclaves where the material is transformed into a hard calcium silicate.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies:

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ASTM Standards:

C22/C22M Specification for Gypsum

C33/C33M Specification for Concrete Aggregates

C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C144 Specification for Aggregate for Masonry Mortar

C150/C150M Specification for Portland Cement

C332 Specification for Lightweight Aggregates for Insulating Concrete

C595/C595M Specification for Blended Hydraulic Cements

C618 Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C1692 Practice for Construction and Testing of Autoclaved Aerated Concrete (AAC) Masonry

E4 Practices for Force Calibration and Verification of Testing Machines

E575 Practice for Reporting Data from Structural Tests of Building Constructions, Elements, Connections, and Assemblies

3 Classification

3.1 AAC units manufactured in accordance with this specification are classified according to their strength class

4. Materials and Manufacture

4.1 Raw Materials—Materials shall conform to the following applicable specifications:

4.1.1 Portland Cement, Specification C150/C150M.

4.1.2 Blended Cements, Specification C595/C595M.

4.1.3 Pozzolan, Specification C618.

4.1.4 Gypsum, Specification C22/C22M.

4.1.5 Aggregates, Specifications C33/C33M, C144, or C3324.

5. Physical Requirements

5.1 Compressive Strength—The compressive strength shall be determined according to Section 6 and shall conform to the requirements of Table 1.

5.2 Dry Bulk Density—The dry bulk density shall be determined according to Section 7 and shall conform to the requirements of Table1.

5.3 Drying Shrinkage—The drying shrinkage shall be determining accordance withSection8, and shall conform to the requirementsofTable1.

5.4 Modulus of Elasticity—If required, the modulus of elasticity shall be determining accordance with Section 9.

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Table 1 Physical requirements[A]

Strength class	Compressive strength (MPa), min	Normal Dry Bulk Density, (kg/m^3)	Normal Dry Bulk Density, (kg/m^3)	
			Lower limit >	Upper limit ≤
AAC-2	2.0	400 500	350 450	450 550
AAC-3	3.0	500 600	450 550	550 650
AAC-4	4.0	500 600	450 550	550 650
AAC-5	5.0	600 700	550 650	650 750
AAC-6	6.0	600 700	550 650	650 750

A The average drying shrinkage requirement of all strength classes is ≤ 0.02 %

6. Determination of Compressive Strength

6.1 Apparatus:

6.1.1 Testing Machine—The testing machine shall conform to the requirements prescribed in Practice E4. The machine shall be equipped with two steel bearing blocks one of which is spherically seated block that will transmit load to the upper surface of the specimen, and the other a plane rigid block on which the specimen will rest.

6.2 Test Specimens:

Three cube specimens of 4in. (100mm) edge length shall be tested in an air-dried condition (5 to 15% by mass moisture content). If the samples have to be dried before testing to reach that moisture content, they shall be stored data temperature not exceeding 70°C.

6.2.2 A minimum of three specimens shall be tested. Whenever possible, one specimen shall be obtained from the upper third of the product, one from the middle, and one from the lower third, determined in the direction of the rising of the mass during manufacture. Otherwise, the position of the cubes and information regarding the rise shall be reported. The direction of the rise shall be noted on all specimens. This is shown in Fig.1.

6.2.3 Loadbearing surfaces of the specimen shall be plane within 0.09mm per 100mm. This can be achieved by grinding, milling, or capping. When capping, a gypsum plaster compound shall be used.

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6.3 Procedure:

6.3.1 The specimen shall be placed in the testing machine and the load applied perpendicular to the direction of rise during manufacture.

6.3.2 Speed of Testing—Apply the load up to one half of the expected maximum load at a convenient rate, after which adjust the controls of the machine as required to give a uniform rate of travel of the moving head such that the remaining load is applied in not less than one nor more than two minutes.

6.3.3 Calculate the compressive strength of each specimen as follows:

$$\text{Compressive strength, } f = \frac{P}{A} \qquad (1)$$

where:

f = compressive strength of the specimen, psi (or Pa),
P = maximum load, lbf (or N), indicated by the testing machine, and
A = gross cross-sectional area of the specimen, in.^{2} (mm^2).

6.4 The compressive strength shall be reported to thenearest10psi (69kPa) for each specimen and as the average

7. Determination of Moisture Content and Bulk Density

7.1 Apparatus:

7.1.1 Balance – shall be sensitive within 0.5% of the mass of the specimen.

7.2 Test Specimens - Three test specimens, as described in 8.2, shall be used for calculating the bulk density.

7.3 Procedure:

7.3.1 Determine the mass of the specimens, and then dry Them in a ventilated oven at 100 to 110°C for not less than 24h, and until two successive determinations of mass at intervals of 2h show an increment of loss not greater than 0.2%of the last previously determined mass of the specimen.

7.3.2Calculate the moisture content of each specimen as follows:

$$\text{Moisture Content \%, } MC = (A - B)/B \times 100 \qquad (2)$$

where:

MC = moisture content, %,
A = sampled mass of specimen, lb (kg), and
B *to* = dry mass of specimen, lb (kg).

7.3.2.1 Report the average moisture content of all of the Specimens as the moisture content of the lot.

7.3.3 Determine the dimensions of the test specimens with a Caliper gauge. Measure the width and height at the ends and in the middle of the length of the specimen. Measure the length on two opposite sides. Determine the volume of the specimen by multiplying the average values of the dimensions.

7.3.4 Calculate the dry bulk density of each specimen as follows:

$$\gamma = B/V \qquad (3)$$

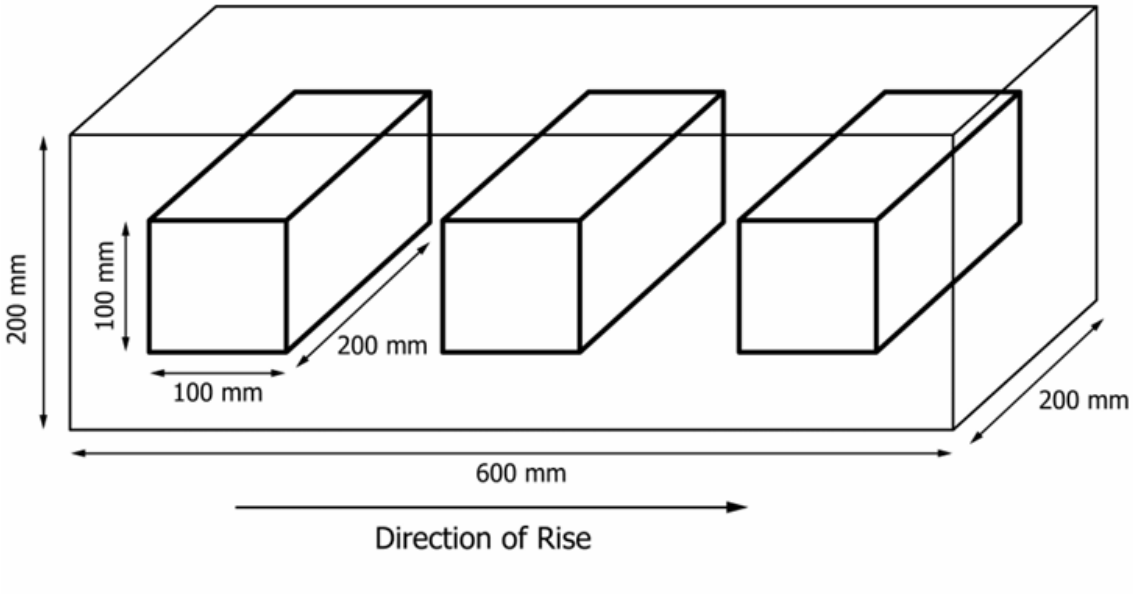
where:

γ = dry bulk density, lb/ft^3 (kg/m^3),
B = dry mass of specimen, lb (kg), and
V = volume of the specimen, ft^3 (m^3).

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7.3.4.1 Report the average dry bulk density of all of the specimens as the dry bulk density of the lot.



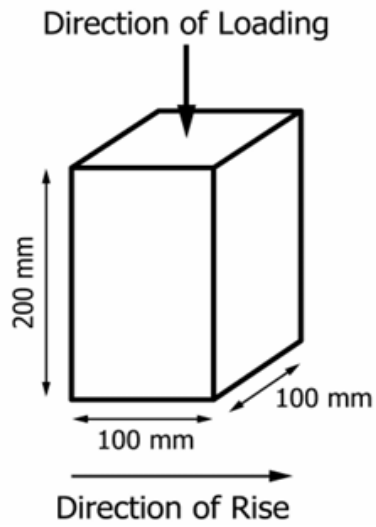


Fig 1 Direction of Loading

8. Determination of Drying Shrinkage

8.1 Apparatus:

8.1.1 Balance, shall be sensitive to within 0.1 % of the mass of the specimen.

8.1.2 Caliper Gauge, shall be accurate to 0.1 mm.

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8.1.3 Temperature Regulated Environment, capable of regulating the temperature to 20 ± 6°C and a minimum relative humidity of 45 % in which the samples are stored during drying and while the measurements in the change in length are performed.

8.1.4 Measuring Instrument, used to determine the change in length of the test samples. Any suitable device shall be permitted to be used provided it meets the following requirements:

8.1.4.1 The instrument shall measure change in length along the longitudinal axis of the sample.

8.1.4.2 The instrument shall be able to make contact with the measurement marks fastened to the face of the samples.

8.1.4.3 The measurements shall be made with an accuracy of $\Delta L/L_{[ogr]} \leq 10^{-6}$, where $L_{[ogr]}$ is the original length of the sample

8.1.4.4 The instrument shall have a measuring precision consistent with the accuracy required in 8.1.4.3.

8.1.4.5 The instrument shall be checked with a measurement standard prior to each measurement.

8.1.5 Measurement Marks, fastened to the faces of the samples, shall be made of a corrosion-resistant material and shaped so that reliable contact with the measuring instrument is assured.

8.1.6 Ventilated Drying Oven, capable of maintaining a temperature of 105 ± 5°C.

8.2 Test Specimens:

8.2.1 Use prism specimens measuring 40 by 40 by 160 mm, and use at least three specimens for each test. Whenever possible, obtain one specimen from the upper third of the product, one from the middle, and one from the lower third, determined by the direction of the rising of the mass during manufacture. Otherwise, report the position of the sample and the direction of rise. Note the direction of rise on all specimens.

8.2.2 The longitudinal axis of the specimen shall be normal to the direction of rise and preferably parallel with the longitudinal direction of the product. Cement the measurement marks or otherwise securely fasten them to the faces of the specimen.

8.3 Measurement and Conditioning of Test Specimens:

8.3.1 Measure the dimensions of the test specimens with a caliper gauge. Measure the width and height at the ends and in the middle of the length of the specimen. Measure the length on two opposite sides. Determine the volume of the specimen by multiplying the average values of the dimensions.

8.3.2 The samples shall be packaged in plastic and stored for a minimum of 24 h at 20 ± 2°C to obtain a uniform moisture distribution. The moisture content shall be determined as follows:

$$MC = (\gamma m - \gamma db)/\gamma db \times 100 \quad (4)$$

where:

γm = m_m/V, wet bulk density as determined by the mass in the damp condition divided by the volume, and

γdb = dry bulk density of a comparative sample as determined in Section 7.

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8.4 Determination of Drying Shrinkage:

8.4.1 Clean the measurement marks before each reading. Make the first determination of length and mass immediately after removing the specimen from the plastic enclosure. Then store the specimen on a grid to allow sufficient movement of air around the specimens in an atmosphere of 20 ± 2°C and a minimum relative humidity of 45%. Determine each specimen's mass and length at regular intervals until the moisture content has decreased to below 4%. At least five determinations shall be made.

8.4.2 The test specimens shall be stored in a drying cabinet at 105 ± 5°C until the mass at two determinations does not change by more than 0.2%. After a constant mass is reached, the measurement marks shall be removed, and the mass determined.

8.5 Calculation of Test Results:

8.5.1 Calculate the relative change in length between readings as follows:

$$\varepsilon_{si} = \frac{(L_{[ogr]} - L_f)}{L_{[ogr]}} \times 100 = \frac{\Delta L}{L_{[ogr]}} \times 100 \qquad (5)$$

where:

ΔL = change in measured length according to 8.4.1 in in. (mm),
$L_{[ogr]}$ = the initial length of the specimen, and
L_f = the final length of the specimen.

8.5.1.1 The relative change in length shall be reported with an accuracy of 0.00001 mm/mm. 8.5.2 The moisture content at each reading time shall be calculated as follows:

$$MC = \frac{(m_i - m_d)}{(m_d - m_{mark})} \times 100 \qquad (6)$$

where:

MC = moisture content,
m_i = mass of the damp sample at the reading time in lb (kg),
m_d = mass of the sample unit after drying in lb (kg), and
m_{mark} = mass of the measurement mark in lb (kg).

8.5.2.1 The moisture content shall be reported with an accuracy of 0.1%.

8.5.3 The average values for the relative change in length and the moisture content for each reading shall be shown graphically and connected by a curve (Fig. 2). The amount of drying shrinkage, ε_{cs}, is the difference in the relative change in length between the moisture contents of 30 and 6%.

9. Determination of the Modulus of Elasticity of AAC in Compression

9.1 Test Apparatus -The test apparatus shall be as follows:

9.1.1 Testing Machine - The testing machine shall conform to Practices E4 (Constant-Rate-of-Traverse CRT-Type Testing Machine). The spherical head and bearing blocks shall con form to the Apparatus

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section of Test Method C39/C39M.

9.1.2 Calipers—Calipers shall allow a reading with a precision of 0.1 mm.

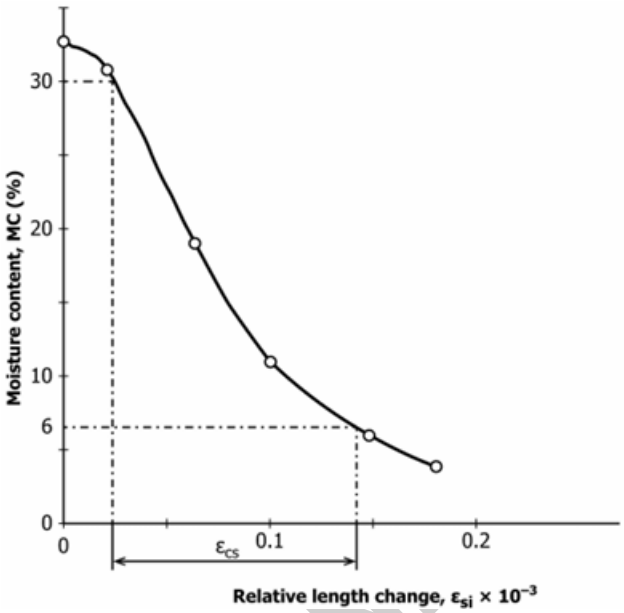


Figure 2. Determination of Drying shrinkage, ε_{cs}

9.1.3 Drying Ovens - Two ovens typically are used for this test procedure; one maintained at a temperature of 105 ± 5°C and another maintained at a temperature of 70 ± 5°C.

9.1.4 Compressometer may be used to determine the strain behavior of the specimen during compression and shall have a precision of 0.001 mm.

9.2 Test Specimens—The test specimens shall be as follows:

9.2.1 Shape of Specimens—The specimens shall be prisms measuring 100 mm by 100 mm by 200 mm Prisms of other sizes or cylindrical specimens shall be permitted to be used provided that the width (diameter) of such other specimens is not less than 75 mm and the ratio between the height and the width shall be 2.

9.2.2 Number and Orientation—A test set shall consist of three specimens. Whenever possible one specimen shall be prepared for the upper third of the product, one from the middle third, and one from the bottom third as determined by the direction of rising of the mass during manufacturing. Prepare the specimens so that the loading is applied to the 100-mm by 100-mm surface and is perpendicular to the direction of rising during manufacture.

9.2.3 Preparation—Dry the specimens to a moisture content between 5 and 15% by weight. After drying and before testing, store the specimens at room temperature until they reach an equilibrium temperature. Prepare the loadbearing surfaces in accordance with 6.2.3.

9.3 Test Procedure—The test procedure shall be as follows:

9.3.1 Determination of Density and Moisture Content— Determine the dry density of comparable specimens and the moisture content of the test specimens according to Specification C1692.

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9.3.2 Determination of Compressive Strength—Using companion specimens, determine the compressive strength in accordance with Test Method C39/C39M.

9.3.3 Determination of Modulus of Elasticity in Compression:

9.3.3.1 Place the uncapped specimen in the testing machine so that the 100-mm by 100 mm surfaces are loaded. Determine and record the dimensions of the loaded surfaces with a precision of ±3 mm. No overall unit dimension (width, height, and length) shall differ by more than 3 mm from the specified dimension.

9.3.3.2 Attach electrical resistance strain gauges or mechanical compressometers to two opposite longitudinal sur faces of the specimen. Place the strain gauges within the middle third of the specimen, as close as possible to the center. When using compressometers, the gauge length shall be 100 ± 2 mm, and the compressometers shall be centered about the middle third of the specimen.

9.3.3.3 Place the specimen in the testing machine and center it to produce concentric loading. Apply a base load equal to 0.33 times the expected compressive strength, f'_{AAC}, and maintain that load for 90 s. During the last 30s of that period, measure the longitudinal strains, ε_{b1} and ε_{b2}. If ε_{b1} and ε_{b2} deviate from their mean value by more than 20%, the applied loading shall be considered eccentric. The specimen shall then be unloaded, realigned, reloaded to 0.33 f'_{AAC}, and the corresponding strains measured.

9.3.3.4 When the strain readings at 0.33 f'_{AAC} are within 20% of their mean value, decrease the load gradually until a value of 0.05 f'_{AAC} is reached (this should take approximately 30s). Maintain this load for 90s, and measure the corresponding strains, ε_{a1} and ε_{a2} during the last 30 s of that period. If the difference in readings from each of the two gauges ($\varepsilon_{b1} - \varepsilon_{a1}$, $\varepsilon_{b2} - \varepsilon_{a2}$) differs by more than 20% from the mean of those differences, the applied loading shall be considered eccentric. The specimen shall then be unloaded, realigned, and the test repeated. If the difference in readings from each of the two gauges ($\varepsilon_{b1} - \varepsilon_{a1}$, $\varepsilon_{b2} - \varepsilon_{a2}$) differs by not more than 20% from the mean of those differences, repeat the above loading cycle. Increase the load to 0.33 f'_{AAC}; read ε_{b1} and ε_{b2} and calculate the average ε_b; decrease the load to 0.05 f'_{AAC}; read ε_{a1} and ε_{a2} and calculate the average ε_a. Use these values to calculate the modulus of elasticity, E_{aac}. After completing this second loading cycle, remove the compressometer and load the specimen to failure. The complete loading cycle is illustrated in Fig. 3.

9. 9.3.3.5 Take all readings under the final loading cycle (Fig. 3).

9.3.3.6 Convert each measure applied compressive load (force) to compressive stress using the formula:

$$f = \frac{F}{A_c} \tag{7}$$

where:

f = calculated applied stress, MPa (psi),
F = measured applied compressive load, N (lbf), and
A_c = area over which the load is applied, mm_2 ($in._2$).

9.3.3.7 If strain gauges are used, record the strain directly. If compressometers are used, calculate the

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compressive strain, ε, as follows:

$$\varepsilon = \frac{\frac{\Delta_a + \Delta_b}{2}}{L_m} \quad (8)$$

where:

Δ_a *and* Δ_b = the change in gage length, and
L_m = gauge lengths.

9.3.3.8 Determine the modulus of elasticity, E_c:

$$E_c = \frac{f_b - f_a}{\varepsilon_b - \varepsilon_a} \quad (9)$$

where:

f_a = stress recorded at 0.05 f'_{AAC},
f_b = stress recorded at 0.33 f'_{AAC},
ε_a = average strain calculated at 0.05 f'_{AAC}, and
ε_b = average strain calculated at 0.33 f'_{AAC}.

9.4 Report—Prepare the report in conformance with Practice E575, and include the following:

9.4.1 The moisture content and dry density of the material,

9.4.2 Identification number of the specimen,

9.4.3 Average width of specimen to the nearest 1.0 mm,

9.4.4 Average depth of specimen to the nearest 1.0 mm,

9.4.5 Mass of specimen, kg,

9.4.6 Maximum applied load, N,

9.4.7 Modulus of Elasticity, MPa,

9.4.8 Defects in specimen,

9.4.9 Description of failure,

9.4.10 AAC grade,

9.4.11 Compressive strength of AAC, MPa, and

9.4.12 Dry Bulk Density of AAC, kg/m^3.

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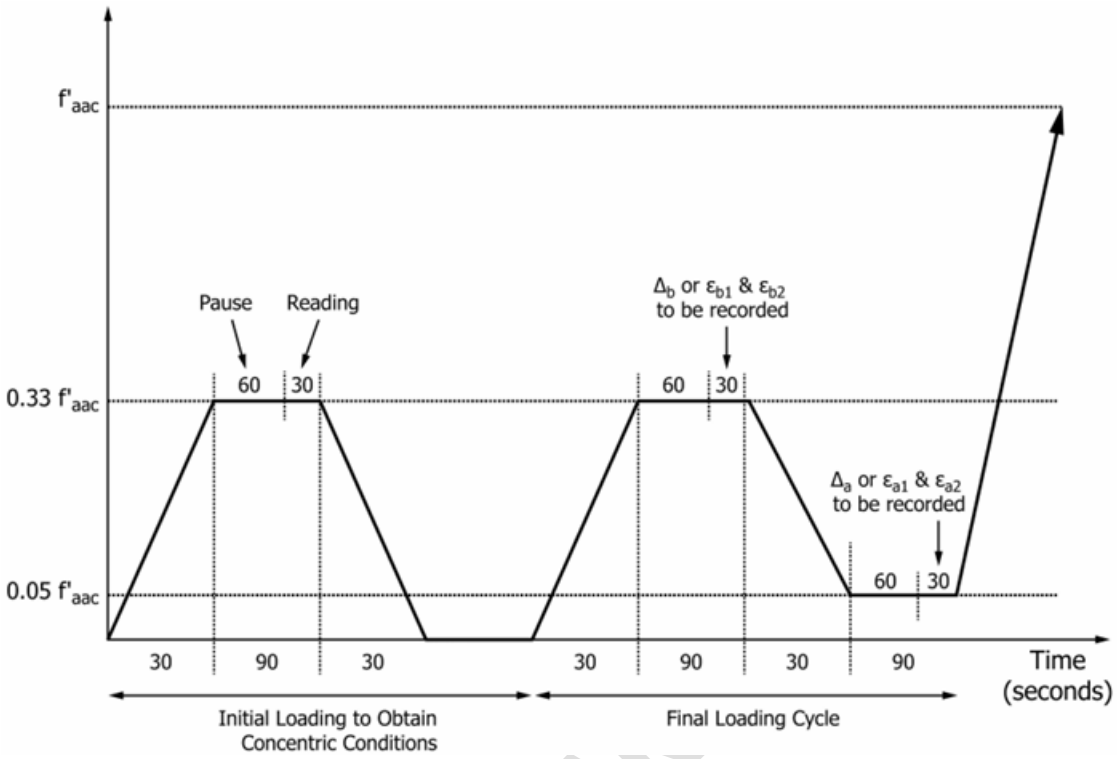


Figure. 3. Modulus of Elasticity Loading Cycle Diagram

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