

**GENERAL RULES FOR
MEASUREMENT OF ROAD WORKS
AND
ROUNDING OFF RATES, QUANTITIES,
VALUES AND AMOUNTS.**

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NECESSITY

- Procedure for ROUNDING OFF is followed in different ways by
 - a) Field officers (AEE/ AE/ DEE),
 - b) Drawing Branch in Division Office,
 - c) Audit Branch in Division Office
 - d) Scrutiny in Circle Office and Head office.
- Such different procedures are leading to confusion among the officers and subordinates.
- In this review, it is presented the actual procedures stipulated by different Codes and Authorities in rounding of rates, quantities, amounts, results and values.

REFERENCES

- 1. IS:2–1960**
Indian Standard Rules for rounding off numerical values
- 2. A code – Para 307**
The Andhra Pradesh Public Works Account Code.
- 3. D code – Section 26**
The Andhra Pradesh Public Works Department Code
- 4. APDSS – Para 68**
The Andhra Pradesh Detailed Standard Specification.
- 5. MoRT&H – Section 113**
Ministry of Road Transport & Highways.
- 6. MS Excel.**

ROUNDING OFF

- DEFINITION

- To round off a value is to retain a certain number of figures, *counted from the left*, and drop the others so as to give a more rational form to the value.

- PURPOSE

- For reporting the result of a test.
 - For reporting the result of a calculation.
 - For drafting specifications.

TERMINOLOGY

- Number of Decimal Places

- It is Number of **FIGURES** counting from the first figure after the decimal point and ending with the last figure on the right.

Examples::

a) 1 Decimal Place :: 123.0, 345.1, 1567.9 .

b) 2 Decimal Places :: 123.00, 345.01, 567.10, 5.99.

c) 3 Decimal Places :: 123.000, 345.001, 567.100, 5.999.

TERMINOLOGY

- Number of Significant Figures

- It is Number of significant **DIGITS** in the value, counting from the left-most **non-zero digit** and ending with the right-most **digit** in the value.

Examples::

a) 1 Significant Figure ::

: 0**1**, **9**, 0.0**4**, 0.00**7**, 0.00000**8**.

b) 3 Significant Figures ::

: 0**1.00**, **9.50**, 0.0**409**, 0.00**761**, 0.00000**890**.

c) 7 Significant Figures ::

: 0**1.000005**, **9.500000**, 0.0**4000009**,
0.000**7610004**, 0.00000**8900045**, **7654321**.

TERMINOLOGY

- Fineness of Rounding

- It is the **UNIT** to which a value is rounded off.
 - (Akin to LEAST COUNT in a measuring instrument).

Examples::

- a) Values Rounded off to the unit **0.1** :: 12.0, 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8, 12.9.
- b) Values Rounded off to the unit **0.01** :: 12.00, 12.91, 12.82, 12.73, 12.64, 12.55, 12.46, 12.57, 12.48, 12.39.
- c) Values Rounded off to the unit **0.001** :: 12.000, 12.081, 12.092, 12.703, 12.904, 12.885, 12.786, 12.127, 12.238, 12.569.

TERMINOLOGY

- Fineness of Rounding

Examples::

d) Values Rounded off to the unit 5 :: 55, 1210, 8900, 45675.

e) Values Rounded off to the unit 1000 :: 5000, 12000, 89000.

f) Values Rounded off to the unit 0.5 :: 12.0, 12.5, 812.5.

g) Values Rounded off to the unit 0.05 :: 12.00, 12.95, 12.85.

h) Values Rounded off to the unit 0.005 :: 12.000, 12.085,

RULES FOR ROUNDING

- Rounding off to fineness : 10, 1, 0.1, 0.01, 0.001, etc..

- *Rule I :: (<5)*

When the figure next beyond the LAST FIGURE to be retained is less than 5, the figure in the last place retained shall be left unchanged.

- *Rule II :(>5)*

When the figure next beyond the LAST FIGURE to be retained is more than 5 or is 5 followed by any figures other than zeros, the figure in the last place retained shall be increased by 1.

RULES FOR ROUNDING

- Rule III : (=5)

When the figure next beyond the last figure to be retained is 5 alone or 5 followed by zeros only, the figure in the last place retained shall be

(a) Increased by 1 if it is **ODD** and

(b) Left unchanged if it is **EVEN**.

(zero would be regarded as an even number).

- Rule IV & V:

Dealt in the slides followed.

RULES FOR ROUNDING - EXAMPLES

- Value :: 7.2604 <-> Fineness of rounding :: 1
 - a) LAST FIGURE to be retained : 7
 - b) FIGURE NEXT beyond the LAST FIGURE : 2
 - c) Condition : $2 < 5$
 - d) Rule to be applied : 1
 - e) Result : LAST FIGURE Un changed.
 - f) Rounded Value : 7

RULES FOR ROUNDING - EXAMPLES

- Value: 7.2604 <-> Fineness of rounding: 0.1
 - a) LAST FIGURE to be retained : 2
 - b) FIGURE NEXT beyond the LAST FIGURE : 6
 - c) Condition : $6 > 5$
 - d) Rule to be applied : II
 - e) Result : LAST FIGURE increased by 1.
 - f) Rounded Value : 7.3

RULES FOR ROUNDING - EXAMPLES

- Value: 7.2604 <-> Fineness of rounding: 0.01
 - a) LAST FIGURE to be retained : 6
 - b) FIGURE NEXT beyond the LAST FIGURE : 0
 - c) Condition : $0 < 5$
 - d) Rule to be applied : I
 - e) Result : LAST FIGURE Un changed
 - f) Rounded Value : 7.26

RULES FOR ROUNDING - EXAMPLES

- Value: **7.2604** \leftrightarrow Fineness of rounding: **0.001**

- a) LAST FIGURE to be retained : **0**
- b) FIGURE NEXT beyond the LAST FIGURE : **4**
- c) Condition : **$4 < 5$**
- d) Rule to be applied : **I**
- e) Result : **LAST FIGURE Un changed**
- f) Rounded Value : **7.260**

EXAMPLE Value : 7.2604

| Fineness of rounding | 1 | 0.1 | 0.01 | 0.001 |
|------------------------------------|------------|---------------|------------|------------|
| LAST FIGURE to be retained | 7 | 2 | 6 | 0 |
| FIGURE NEXT beyond the LAST FIGURE | 2 | 6 | 0 | 4 |
| Condition | <5 | >5 | <5 | <5 |
| Rule to be applied | I | II | I | I |
| Result | Un changed | Increased by1 | Un changed | Un changed |
| Rounded Value | 7 | 7.3 | 7.26 | 7.260 |

EXAMPLE Value :14.725

| Fineness of rounding | 1 | 0.1 | 0.01 | 0.001 |
|-------------------------------------|----------------|------------|---------------|------------|
| LAST FIGURE to be retained | 4 | 7 | 2 | 5 |
| FIGURE NEXT beyond the LAST FIGURE | 7 | 2 | 5 | -- |
| Condition | >5 | <5 | =5 | -- |
| LAST FIGURE to be retained-EVEN/ODD | -- | -- | EVEN | -- |
| Rule to be applied | I | II | III(b) | -- |
| Result | Increased by 1 | Un changed | Un changed | Un changed |
| Rounded Value | 15 | 14.7 | 14.72 | 14.725 |

EXAMPLE Value :3.455

| Fineness of rounding | 1 | 0.1 | 0.01 | 0.001 |
|-------------------------------------|----------------|------------|------------|------------|
| LAST FIGURE to be retained | 3 | 4 | 5 | 5 |
| FIGURE NEXT beyond the LAST FIGURE | 4 | 5 | 5 | -- |
| Condition | <5 | =5 | =5 | -- |
| LAST FIGURE to be retained-EVEN/ODD | -- | EVEN | ODD | -- |
| Rule to be applied | I | II | III(b) | -- |
| Result | Increased by 1 | Un changed | Un changed | Un changed |
| Rounded Value | 15 | 14.7 | 14.72 | 14.725 |

EXAMPLE Value :0.04950

| Fineness of rounding | 1 | 0.1 | 0.01 | 0.001 |
|-------------------------------------|------------|------------|----------------|----------------|
| LAST FIGURE to be retained | 0 | 0 | 4 | 9 |
| FIGURE NEXT beyond the LAST FIGURE | 0 | 4 | 9 | 5 |
| Condition | <5 | <5 | >5 | =5 |
| LAST FIGURE to be retained-EVEN/ODD | -- | -- | -- | ODD |
| Rule to be applied | I | I | II | III(a) |
| Result | Un changed | Un changed | Increased by 1 | Increased by 1 |
| Rounded Value | 0 | 0 | 0.05 | 0.050 |

FROM IS : 2 - 1960

EXAMPLES OF ROUNDING OFF VALUES TO UNIT FINENESS

| VALUE | FINENESS OF ROUNDING | | | | | | | |
|------------|----------------------|------|---------------|------|---------------|--------|---------------|--------|
| | 1 | | 0.1 | | 0.01 | | 0.001 | |
| | Rounded Value | Rule | Rounded Value | Rule | Rounded Value | Rule | Rounded Value | Rule |
| 7.260 4 | 7 | I | 7.3 | II | 7.26 | I | 7.260 | I |
| 14.725 | 15 | II | 14.7 | I | 14.72 | III(b) | 14.725 | — |
| 3.455 | 3 | I | 3.5 | II | 3.46 | III(a) | 3.455 | — |
| 13.545 001 | 14 | II | 13.5 | I | 13.55 | II | 13.545 | I |
| 8.725 | 9 | II | 8.7 | I | 8.72 | III(b) | 8.725 | — |
| 19.205 | 19 | I | 19.2 | I | 19.20 | III(b) | 19.205 | — |
| 0.549 9 | 1 | II | 0.5 | I | 0.55 | II | 0.550 | II |
| 0.650 1 | 1 | II | 0.7 | II | 0.65 | I | 0.650 | I |
| 0.049 50 | 0 | I | 0.0 | I | 0.05 | II | 0.050 | III(a) |

Further RULES FOR ROUNDING

- Rule IV :

Not much useful for Highway Engineers.

- Rule V: Rounding off to fineness 50, 5, 0.5, 0.05, 0.005, etc.:
- Step i) Double the value of number -> New Value.
- Step ii) Double the value of fineness -> New Fineness.
- Step iii) Round the New Value with New Fineness as per Rule I, II and III.
- Step iv) Half the above value for **FINAL ROUNDED VALUE**.

EXAMPLE Value :975.0495

| Fineness of rounding | 50 | 0.5 | 0.05 | 0.005 |
|--|----------|----------|----------|----------|
| Double the value | 1950.099 | 1950.099 | 1950.099 | 1950.099 |
| Double the value of fineness | 100 | 1 | 0.1 | 0.01 |
| Round the New Value with New Fineness | 2000 | 1950 | 1950.1 | 1950.10 |
| Half the above value for final rounded value | 1000 | 975 | 975.05 | 975.050 |

EXCEL FORMULA

- Fineness of Rounding – EXCEL FORMULA

- a) Fineness of Rounding 0.1 :: ROUND(B2,1)
- b) Fineness of Rounding 0.01 :: ROUND(B2,2)
- c) Fineness of Rounding 0.001 :: ROUND(B2,3)
- d) Fineness of Rounding 1 :: ROUND(B2,0)
- e) Fineness of Rounding 10 :: ROUND(B2,-1)
- d) Fineness of Rounding 1000 :: ROUND(B2,-3)
- e) Fineness of Rounding 5 :: ROUND(B2/5,0)*5
- f) Fineness of Rounding 0.5 :: ROUND(B2/0.5,0)*0.5
- g) Fineness of Rounding 0.05 :: ROUND(B2/0.05,0)*0.05
- h) Fineness of Rounding 0.005 :: ROUND(B2/0.005,0)*0.005

SUCCESSIVE ROUNDING

- Rule :

The final rounded value shall be obtained from the most precise value available in one step only and **NOT FROM A SERIES OF SUCCESSIVE ROUNDING.**

For example, the value **0.5499**, when rounded to one significant figure, shall be written as **0.5** and not as **0.6** which is obtained as a result of successive roundings to **0.550**, **0.55**, and **0.6**.

Similarly, **0.6501** shall be rounded off to **0.7** in one step and not successively to **0.650**, **0.65** and **0.6**, since the most precise value available here is nearer to **0.7** than to **0.6**.

A-CODE (Para 307) & APDSS (Para 68)

BILLS

- VALUE of Item of Work : (5 Paise)

The VALUE of each item of work should be calculated to the nearest 5 paise.

1 and 2 paise should be omitted.

3 and 4 paise should be reckoned as 5 paise.

- RATE of Item of Work : (1 Paise)

The RATE of each item of work should be nearest 1 paise.

- TOTAL Amount of Bill: (1 Rupee)

The TOTAL amount of each bill should be nearest 1 rupee.

1 to 49 paise should be omitted.

50 to 100 paise should be reckoned as 1 rupee.

D-CODE (Section no. 26)

ESTIMATE RATES

i. RATE less than Rs. 5/-: (5 Paise)

The RATE of each item of work should be calculated to the **NEAREST 5 PAISE**.

1 and 2 paise should be ignored.

3 and 4 paise should be rounded off 5 paise.

Rs. 4.35 instead of 4.33 Rs. 4.30 instead of 4.31

ii. RATE more than Rs. 5/- but below Rs. 50/-: (10 Paise)

The RATE of each item of work should be calculated to the **NEAREST 10 PAISE** That is the rate should have only one decimal not two.

8Rs. 8.3 instead of 8.27 Rs.15.2 instead of 15.24

ESTIMATE RATES

iii. RATE more than Rs. 50/- but below Rs. 1000/-: (1 Rupee)

The RATE of each item of work should be calculated to the **NEAREST 1 RUPEE** or whole number. That is the rate should have no decimal.

Rs.89/- instead of 89.45 Rs. 486/- instead of 485.82

iv. RATES above Rs.1000/-

The RATE of each item of work should be calculated to the nearest 10 rupees.

Rs.1120/- instead of 1122.

Rs. 5630/- instead of 5628.

D-CODE (Section no. 26)

ESTIMATED AMOUNTS & ESTIMATED QUANTITIES

The ESTIMATED QUANTITIES should be rounded off as follows.

i. *QUANTITIES in 3 Digits or less (0 to 999) (Rs.1)*

Rounded off to whole number, that is to nearest 1 rupee.

Rs.9 instead of 9.35

Rs. 323 instead of 323.25.

ii. *QUANTITIES in 4 Digits (1000 to 9999) (Rs.10)*

Rounded off to nearest 10 rupee.

Rs.4720 instead of 4723.

Rs. 5670 instead of 5668.

ESTIMATED AMOUNTS & ESTIMATED QUANTITIES

iii. QUANTITIES in 5 Digits (10000 to 99999) (Rs.100)

Rounded of to 100 rupees.

Rs.66400 instead of 66385

Rs. 98700 instead of 98749

iv. QUANTITIES in 6 Digits (100000 to 999999) (Rs.1000)

Rounded of to nearest 1000 rupee.

Rs.423000 instead of 423470.

Rs. 609000 instead of 608505

ESTIMATED AMOUNTS & ESTIMATED QUANTITIES

v. QUANTITIES in Lakhs (Rs. Thousands)

Rounded of to Thousand rupees.

Rs. 6.23 Lakhs instead of 6,23,460

Rs. 8.78 Lakhs instead of 8,77,560

vi. QUANTITIES in Crores (Rs. Lakhs)

Rounded of to Lakhs rupee.

Rs.5.44 Crores instead of 5,43,74,500

Rs. 9.67 Crores instead of 9,67,49,900

D-CODE (Section no. 26)

TENDER PERCENTAGE

- ❖ The tender percentages for the purposes of
 - (i) Evaluation of tenders,
 - (ii) Fixation of rates in agreements and
 - (iii) Fixation of rates in supplemental agreements
- Shall be rounded off to **SECOND DECIMAL.**

M O R T & H Section 113

MEASUREMENTS & COMPUTATIONS

All measurements shall be made in the **METRIC SYSTEM**.

a) All **MEASUREMENTS AND COMPUTATIONS** shall be carried nearest to the following limits.

- | | |
|--|--------------------------|
| <i>i. Length and Width</i> | 10 mm – 0.01 m |
| <i>ii. Height, Depth or Thickness</i> | |
| <i>i. Earthwork, Subgrade</i> | 5 mm - 0.005 m |
| <i>ii. Sub-bases, Bases, Surfacing</i> | 5 mm - 0.005 m |
| <i>iii. Structural members</i> | 2.5 mm – 0.0025 m |
| <i>iv. Areas</i> | - 0.01 sqm |
| <i>v. Volume</i> | - 0.01 cum |

MEASUREMENTS & COMPUTATIONS for LEADS

- b) **LEAD** shall be measured over the shortest practicable route and not one actually taken.
- i. *Distance up to and including 100 m*
Shall be measured in units of 50 m
 - ii. *Distance exceeding 100 m up to 1 km*
Shall be measured in units of 100 m
 - iii. *Distance exceeding 1 km*
Shall be measured in units of 500 m
0 – 499 m shall be ignored.
500 – 1000 m shall be reckoned as 1.0 km.

MEASUREMENTS & COMPUTATIONS for PAVEMENTS

- c) The finished thickness of sub-bases, base and bituminous layers and concrete courses paid on volume basis shall be computed in the following manner.

Levels shall be taken before and after construction at the grid points.

i. Longitudinally

- *10 m centre-to-centre in straight reaches.*
- *5 m centre-to-centre in curved reaches.*

ii. Transversely (From either edge of the carriageway)

- *On Two Lane roads at 0.75 m and 2.75 m*
From either edge of the carriageway – 4 positions.
- *On Single- Lane roads at 1.25 m*
From either edge of the carriageway - 2 positions.

MEASUREMENTS & COMPUTATIONS for PAVEMENTS

ii. Transversely (From either edge of the carriageway)

➤ *On Multi- Lane roads at 0.75 m*

From either edge of the carriageway

+ And the remaining locations shall be at equi-distance in the balance portion of the carriageway.

THANKYOU