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2-Variable Templates for Magic Squares

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ABSTRACT - Two basic templates of size 4 for different specified locations of 4 numbers are derived. However, they have repeated numbers. This is overcome by adding and subtracting suitable values of two variables. Several examples are given for obtaining the magic squares from these templates. Several alternative magic squares are obtained for the well-known Ramanujan's birthdate magic square. A MS of a desired magic constant is obtained from that of a known magic constant. Applications of these templates are mentioned. A large number of magic squares can be obtained from any specified magic constant.

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I. INTRODUCTION

A general square of order 4 is expressed as in Equation (1).

$$\begin{bmatrix} S_{11} & S_{12} & S_{13} & S_{14} \\ S_{21} & S_{22} & S_{23} & S_{24} \\ S_{31} & S_{32} & S_{33} & S_{34} \\ S_{41} & S_{42} & S_{43} & S_{44} \end{bmatrix}. \tag{1}$$

Several magic squares (MSs) that deal with the 4 numbers *a, b, c, d* (each of 2 digits corresponding to the birthdate) placed in the *first row* are popular shown by Equation (2) [1].

$$M_S = \begin{bmatrix} \boldsymbol{a} & \boldsymbol{b} & \boldsymbol{c} & \boldsymbol{d} \\ S_{21} & S_{22} & S_{23} & S_{24} \\ S_{31} & S_{32} & S_{33} & S_{34} \\ S_{41} & S_{42} & S_{43} & S_{44} \end{bmatrix} \tag{2}$$

where

$$a + b + c + d = S. \tag{3}$$

S is called the magic number (MN). Recently, Sharma and Rathore [2] have proposed MS which has these numbers placed at *the centre* as shown in Equation (4). *The two controlling variables X and Y are placed in the first row.*

$$M_S = \begin{bmatrix} \boldsymbol{X} & \boldsymbol{Y} & S_{13} & S_{14} \\ S_{21} & \boldsymbol{a} & \boldsymbol{b} & S_{24} \\ S_{31} & \boldsymbol{c} & \boldsymbol{d} & S_{34} \\ S_{41} & S_{42} & S_{43} & S_{44} \end{bmatrix} \tag{4}$$

The template [2] used was

$$T_s = \begin{bmatrix} \boldsymbol{X} & \boldsymbol{Y} & (c+d) - y & (a+b) - X \\ (b+c+d) - (X+Y) & \boldsymbol{a} & \boldsymbol{b} & (X+Y) - b \\ (a+b-d) - (X-Y) & \boldsymbol{c} & \boldsymbol{d} & d + (X-Y) \\ X - (b-d) & (b+d) - Y & Y - (d-a) & (b+c) - X \end{bmatrix}. \tag{5}$$

An alternate template [3] is shown in Equation (6) where *X* and *Y* are placed at the corners of the first row [3].

$$T_S = \begin{bmatrix} \boldsymbol{X} & (c+d) - Y & (a+b) - X & \boldsymbol{Y} \\ c - X & \boldsymbol{a} & \boldsymbol{b} & Y + d \\ b + Y & \boldsymbol{c} & \boldsymbol{d} & a - Y \\ (a+d) - Y & Y - (c-b) & X - (b-c) & (b+c) - X \end{bmatrix}. \tag{6}$$

Since *X* and *Y* are appearing as single terms, they cannot be negative, and/or equal.

In the present paper, a systematic method is developed for deriving the templates for 4 × 4 MSs which have *different locations* of a specified quartet (SQ) {*a, b, c, d*} in the next section.

II. Basic Templates

2.1 Basic Templates

A 4 × 4 square is shown in Figure 1(a) where * represents an integer.

$$\begin{bmatrix} * & * & * & * \\ * & * & * & * \\ * & * & * & * \\ * & * & * & * \end{bmatrix} \qquad \begin{bmatrix} a & b & c & d \\ * & * & * & * \\ * & * & * & * \\ * & * & * & * \end{bmatrix}$$

(a) (b)

$$T_1 = \begin{bmatrix} a & b & c & d \\ * & c & b & * \\ * & a & d & * \\ c & * & * & b \end{bmatrix}, \ T_2 = \begin{bmatrix} a & b & c & d \\ * & d & a & * \\ * & c & b & * \\ b & * & * & c \end{bmatrix}$$

(c)

$$T_1 = \begin{bmatrix} a & b & c & d \\ * & c & b & * \\ * & a & d & * \\ c & d & a & b \end{bmatrix}, \ T_2 = \begin{bmatrix} a & b & c & d \\ * & d & a & * \\ * & c & b & * \\ b & a & d & c \end{bmatrix}$$

(d)

$$T_1 = \begin{bmatrix} a & b & c & d \\ d & c & b & a \\ b & a & d & c \\ c & d & a & b \end{bmatrix}, \ T_2 = \begin{bmatrix} a & b & c & d \\ c & d & a & b \\ d & c & b & a \\ b & a & d & c \end{bmatrix}$$

(e)

Figure 1. Derivation of 2 basic templates

Let the SQ be placed in the first row as shown in Figure 1(b) by red colour such that Equation 3 is satisfied. Next, fix up the two diagonals in violet colour such that the sum of the numbers is *S*. The only 2 possible ways are shown in Figure 1(c). Next, fill in the two middle columns so that sum is *S* as shown in Figure 1(d) in blue colour. Finaly, complete the middle rows maintaining the sum *S* shown in green colour in Figure 1(e). Templates T_1 and T_2 have the same sum for rows, columns, diagonals, centre square, corners. These will be called as *basic templates*.

III. Two-Variable Templates

In the templates T_1 and T_2, the numbers *a, b, c, d* are repeated. Therefore, we have to apply add-subtract technique without disturbing the specified location of the numbers in the first row and the sum properties of the diagonals, columns and rows. The different ways of addition and subtraction when carried out gives rise to different MSs. One simple way of doing this is to add the variables $x_i \neq 0$, $i = 1$ to 6 as Equation (7).

$$T_1 = \begin{bmatrix} a & b & c & d \\ d + x_1 & c + x_2 & b + x_3 & a - x_1 - x_2 - x_3 \\ b + x_4 & a + x_5 & d + x_6 & c - x_4 - x_5 - x_6 \\ c - x_3 - x_5 & d - x_2 - x_5 & a - x_3 - x_6 & b - x_2 - x_6 \end{bmatrix}. \tag{7}$$

To satisfy the sum properties for the 1st column and 4th row, the conditions are

$$x_1 = x_3,\ x_4 = x_5 \text{ and } x_2 = - x_3 - x_5 - x_6. \tag{8}$$

Substituting for x_1, x_4 and x_2, we get

$$T_1 = \begin{bmatrix} a & b & c & d \\ d + x_3 & c - x_3 - x_5 - x_6 & b + x_3 & a + x5 + x6 - x3 \\ b + x_5 & a + x_5 & d + x_6 & c - 2x_5 - x_6 \\ c - x_3 - x_5 & d + x_3 + x_6 & a - x_3 - x_6 & b + x_3 + x_5 \end{bmatrix}. \tag{9}$$

Thus, we have reduced 3 variables. To reduce further, we choose

$$x_6 = x_5. \tag{10}$$

In view of the condition in Equation (10), Equation (9) reduces to

$$T_1 = \begin{bmatrix} a & b & c & d \\ d + x_3 & c - x_3 - 2x_5 & b + x_3 & a - x_3 + 2x_5 \\ b + x_5 & a + x_5 & d + x_5 & c - 3x_5 \\ c - x_3 - x_5 & d + x_3 + x_5 & a - x_3 - x_5 & b + x_3 + x_5 \end{bmatrix}. \tag{11}$$

Replacing $\{x_3, x_5\}$ by $\{X, Y\}$, we get

$$T_1 = \begin{bmatrix} a & b & c & d \\ d + X & c - X - 2Y & b + X & a - X + 2Y \\ b + Y & a + Y & d + Y & c - 3Y \\ c - X - Y & d + X + Y & a - X - Y & b + X + Y \end{bmatrix}. \tag{12}$$

This is the 2-variable (X and Y) template where a, b, c, d are located in the first row. This will be referred to TR1 where R1 represents the first row. A number of MSs can be obtained by choosing all possible values of X and Y. The only restriction on these variables is that the numbers should not repeat. Because of the additions of the variables, the *basic* templates of Figure 1(e) will turn into an *ordinary* template shown in Equation (12).

The following 6 types of templates, depending upon the location of the *SQ,* will be derived.

1. In any row (4 cases R1, R2, R3, R4)
2. In any column (4 cases: C1, C2, C3, C4)
3. In any diagonal (2 cases: FD forward diagonal, RD reverse diagonal)
4. At Central Square (CS) (1 case, central square)
5. At 2×2 squares (4 cases: TLS top left square, BLS bottom left square, TRS top right square, BRS bottom right square)
6. At four corners

Like TR1, we obtained the templates for other cases and summarized in Table 1.

Instead of $x_6 = x_5$, one may choose $x_6 = x_3$. This will yield another template

$$T_{R1}{}^{*} = \begin{bmatrix} a & b & c & d \\ d+X & c-2X-Y & b+X & a+Y \\ b+Y & a+Y & d+X & c-2Y-X \\ c-X-Y & d+2X & a-2X & b+X+Y \end{bmatrix}. \quad (13)$$

Table: Templates with different locations of SQ

Template	Remarks
$T_{R1} = \begin{bmatrix} \mathbf{a} & \mathbf{b} & \mathbf{c} & \mathbf{d} \\ d+X & c-X-2Y & b+X & a-X+2Y \\ b+Y & a+Y & d+Y & c-3Y \\ c-X-Y & d+X+Y & a-X-Y & b+X+Y \end{bmatrix}$	
$T_{R2} = \begin{bmatrix} d+X & c+Y & b+Y & a-X-2Y \\ \mathbf{a} & \mathbf{b} & \mathbf{c} & \mathbf{d} \\ c-2X & d+2Y & a-2Y & b+2X \\ b+X & a-3Y & d+Y & c-X+2Y \end{bmatrix}$	
$T_{R3} = \begin{bmatrix} a+X & b+Y & c+Y & d-X-2Y \\ c-2X & d-2Y & a+2Y & b+2X \\ \mathbf{a} & \mathbf{b} & \mathbf{c} & \mathbf{d} \\ c+X & d+Y & a-3Y & b-X+2Y \end{bmatrix}$	
$T_{R4} = \begin{bmatrix} c-X-Y & d+X+Y & a-X-Y & b+X+Y \\ d+X & a+Y & d+Y & a-X+2Y \\ b+Y & c-X-2Y & b+X & c-3Y \\ \mathbf{a} & \mathbf{b} & \mathbf{c} & \mathbf{d} \end{bmatrix}$	Interchange first and fourth rows and then replace $S_{22} \leftrightarrow S_{32}$, $S_{23} \leftrightarrow S_{33}$ in T_{R1}
$T_{C1} = \begin{bmatrix} \mathbf{a} & d+X & b+Y & c-X-Y \\ \mathbf{b} & c-X-2Y & a+Y & d+X+Y \\ \mathbf{c} & b+X & d+Y & a-X-Y \\ \mathbf{d} & a-X+2Y & c-3Y & b+X+Y \end{bmatrix}$	Change S_{ij} to S_{ji} in T_{R1}.
$T_{C2} = \begin{bmatrix} d+X & \mathbf{a} & c-2X & b+X \\ c+Y & \mathbf{b} & d+2Y & a-3Y \\ b+Y & \mathbf{c} & a-2Y & d+Y \\ a-X-2Y & \mathbf{d} & b+2X & c-X+2Y \end{bmatrix}$	Change S_{ij} to S_{ji} in T_{R2}.
$T_{C3} = \begin{bmatrix} d+X & \mathbf{b-2X} & a & c+X \\ c+Y & a-2Y & b & d-3Y \\ b+Y & \mathbf{d+2Y} & c & a-Y \\ a-X-2Y & c+2X & d & b-X+2Y \end{bmatrix}$	Change S_{ij} to S_{ji} in T_{R3}

$T_{C4} = \begin{bmatrix} c-X-Y & d+X & b+Y & \boldsymbol{a} \\ d+X+Y & a+y & c-X-2Y & \boldsymbol{b} \\ a-X-Y & d+Y & b+X & \boldsymbol{c} \\ b+X+Y & a-X+2Y & c-3Y & \boldsymbol{d} \end{bmatrix}$	Change S_{ij} to S_{ji} in T_{R4}.
$T_{FD} = \begin{bmatrix} \boldsymbol{a} & d+X+2Y & b-Y & c-X-Y \\ c+2Y & \boldsymbol{b} & d-Y & a-Y \\ d-X-3Y & a+Y & \boldsymbol{c} & b+X+2Y \\ b+X+Y & c-X-3Y & a+2Y & \boldsymbol{d} \end{bmatrix}$	
$T_{RD} = \begin{bmatrix} b+X & c+Y & a-X-Y & \boldsymbol{d} \\ d+2Y & a+2X & \boldsymbol{c} & b-2Y-2X \\ c-X-2Y & \boldsymbol{b} & d-2X & a+3X+2Y \\ \boldsymbol{a} & d-Y-2X & b+3X+Y & c-X \end{bmatrix}$	
$T_{CS} = \begin{bmatrix} c+X & b+Y & a+X & d-2X-Y \\ d-2X & \boldsymbol{a} & \boldsymbol{b} & c+2X \\ b-X-Y & \boldsymbol{c} & \boldsymbol{d} & a+X+Y \\ a+2X+Y & d-Y & c-X & b-X \end{bmatrix}$	
$T_{TLS} = \begin{bmatrix} \boldsymbol{a} & \boldsymbol{b} & c+X & d-X \\ \boldsymbol{d} & \boldsymbol{c} & b+Y & a-Y \\ b-X+2Y & a+Y & d-2Y & c+X-Y \\ c+X-2Y & d-Y & a-X+Y & b+2Y \end{bmatrix}$	
$T_{BLS} = \begin{bmatrix} b-X+2Y & a+Y & d-2Y & c+X-Y \\ c+X-2Y & d-Y & a-X+Y & b+2Y \\ \boldsymbol{a} & \boldsymbol{b} & c+X & d-X \\ \boldsymbol{d} & \boldsymbol{c} & b+Y & a-Y \end{bmatrix}$	Interchange the first two rows with the last two rows of T_{TLS}
$T_{BLS} = \begin{bmatrix} c+X & d-X & \boldsymbol{a} & \boldsymbol{b} \\ b+Y & a-Y & \boldsymbol{d} & \boldsymbol{c} \\ d-2Y & c+X-Y & b-X+2Y & a+Y \\ a-X+Y & b+2Y & c+X-2Y & d-Y \end{bmatrix}$	Interchange the first two columns with the last two columns of T_{TLS}
$T_{BRS} = \begin{bmatrix} d-2Y & c+X-Y & b-X+2Y & a+Y \\ a-X+Y & b+2Y & c+X-2Y & d-Y \\ c+X & d-X & \boldsymbol{a} & \boldsymbol{b} \\ b+Y & a-Y & \boldsymbol{d} & \boldsymbol{c} \end{bmatrix}$	Interchange the first two rows with the last two rows of T_{BLS}
$T_{4C} = \begin{bmatrix} \boldsymbol{a} & \boldsymbol{c}+X & d-X & \boldsymbol{b} \\ b+2Y & d+X & \boldsymbol{c}-X & a-2Y \\ c-2Y & a+X & b-X & d+2Y \\ \boldsymbol{d} & b-\boldsymbol{3}X & a+\boldsymbol{3}X & \boldsymbol{c} \end{bmatrix}$	

Table 2: MSs for SQ = {22,12,18,87}

{X, Y}	**Magic Squares**
{2, 5}	$M_{R1} = \begin{bmatrix} \mathbf{22} & \mathbf{12} & \mathbf{18} & \mathbf{87} \\ 89 & 06 & 14 & 30 \\ 17 & 27 & 92 & 03 \\ 11 & 84 & 15 & 19 \end{bmatrix}$
{-5, -4}	$M_{R2} = \begin{bmatrix} 82 & 14 & 08 & 35 \\ \mathbf{22} & \mathbf{12} & \mathbf{18} & \mathbf{87} \\ 28 & 79 & 30 & 02 \\ 07 & 34 & 83 & 15 \end{bmatrix}$

{X, Y}	**Magic Squares**
{5,8}	$M_{C1} = \begin{bmatrix} \mathbf{22} & 92 & 20 & 05 \\ \mathbf{12} & 28 & 31 & 68 \\ \mathbf{18} & 16 & 64 & 41 \\ \mathbf{87} & 03 & 24 & 25 \end{bmatrix}$
{-5,-4}	$M_{C2} = \begin{bmatrix} 82 & \mathbf{22} & 28 & 07 \\ 14 & \mathbf{12} & 79 & 34 \\ 08 & \mathbf{18} & 30 & 83 \\ 35 & \mathbf{87} & 02 & 15 \end{bmatrix}$

{*X*, *Y*}	Magic Squares	{*X*, *Y*}	Magic Squares
{-1. -3}	$M_{R3} = \begin{bmatrix} 86 & 15 & 09 & 29 \\ 14 & 28 & 81 & 16 \\ 22 & 12 & 18 & 87 \\ 17 & 84 & 31 & 07 \end{bmatrix}$	{-1, -3}	$M_{C3} = \begin{bmatrix} 86 & 14 & 22 & 17 \\ 15 & 28 & 12 & 84 \\ 09 & 81 & 18 & 31 \\ 29 & 16 & 87 & 07 \end{bmatrix}$
{2,5}	$M_{R4} = \begin{bmatrix} 11 & 84 & 15 & 19 \\ 89 & 27 & 92 & 30 \\ 17 & 06 & 14 & 03 \\ 22 & 12 & 18 & 87 \end{bmatrix}$	{5,8}	$M_{C4} = \begin{bmatrix} 05 & 92 & 20 & 22 \\ 68 & 28 & 31 & 12 \\ 41 & 16 & 64 & 18 \\ 25 & 03 & 24 & 87 \end{bmatrix}$
{5,8}	$T_{C1} = \begin{bmatrix} 22 & 92 & 20 & 05 \\ 12 & 28 & 31 & 68 \\ 18 & 16 & 64 & 41 \\ 87 & 03 & 24 & 25 \end{bmatrix}$	{1, 3}	$T_{CS} = \begin{bmatrix} 19 & 15 & 23 & 82 \\ 85 & 22 & 12 & 20 \\ 08 & 18 & 87 & 26 \\ 27 & 84 & 17 & 11 \end{bmatrix}$
{-5,-4}	$T_{C2} = \begin{bmatrix} 82 & 22 & 28 & 07 \\ 14 & 12 & 79 & 34 \\ 08 & 18 & 30 & 83 \\ 35 & 87 & 02 & 15 \end{bmatrix}$	{-2, -5}	$T_{TLC} = \begin{bmatrix} 22 & 12 & 16 & 89 \\ 87 & 18 & 07 & 27 \\ 04 & 17 & 97 & 21 \\ 26 & 92 & 19 & 02 \end{bmatrix}$
{-1, -3}	$T_{C3} = \begin{bmatrix} 86 & 14 & 22 & 17 \\ 15 & 28 & 12 & 84 \\ 09 & 81 & 18 & 31 \\ 29 & 16 & 87 & 07 \end{bmatrix}.$	{-2, -5}	$T_{BLC} = \begin{bmatrix} 04 & 17 & 97 & 21 \\ 26 & 92 & 19 & 02 \\ 22 & 12 & 16 & 89 \\ 87 & 18 & 07 & 27 \end{bmatrix}$
{5,8}	$T_{C4} = \begin{bmatrix} 05 & 92 & 20 & 22 \\ 68 & 28 & 31 & 12 \\ 41 & 16 & 64 & 18 \\ 25 & 03 & 24 & 87 \end{bmatrix}$	{-2, -5}	$T_{TLC} = \begin{bmatrix} 16 & 89 & 22 & 12 \\ 07 & 27 & 87 & 18 \\ 97 & 21 & 04 & 17 \\ 19 & 02 & 26 & 92 \end{bmatrix}$
{5,3}	$T_{FD} = \begin{bmatrix} 22 & 98 & 09 & 10 \\ 24 & 12 & 84 & 19 \\ 73 & 25 & 18 & 23 \\ 20 & 04 & 28 & 87 \end{bmatrix}$	{-2, -5}	$T_{BRC} = \begin{bmatrix} 97 & 21 & 04 & 17 \\ 19 & 02 & 26 & 92 \\ 16 & 89 & 22 & 12 \\ 07 & 27 & 87 & 18 \end{bmatrix}$
{3,2}	$T_{RD} = \begin{bmatrix} 15 & 20 & 17 & 87 \\ 91 & 28 & 18 & 02 \\ 11 & 12 & 81 & 35 \\ 22 & 79 & 23 & 15 \end{bmatrix}$	{1, 2}	$T_{4C} = \begin{bmatrix} 22 & 19 & 86 & 12 \\ 14 & 88 & 17 & 20 \\ 16 & 23 & 11 & 89 \\ 87 & 09 & 25 & 18 \end{bmatrix}.$

We will deal with T_{R1}. Similar results can be obtained for T_{R1}*.

Example 1: For SQ = {22, 12, 18, 87}, all MSs are shown in Table 2. Note that MS R1 is an alternative to the Ramanujan's MS [1].

IV. APPLICATIONS

Example 2: Let {*a*, *b*, *c*, *d*} = {29, 10, 19, 43}, *S* = 101.
Using T_{C1} template and choosing {*X*, *Y*} = {1,3}

$$M_{C1} = \begin{bmatrix} 29 & 44 & 13 & 15 \\ 10 & 12 & 32 & 47 \\ 19 & 11 & 46 & 25 \\ 43 & 34 & 10 & 14 \end{bmatrix} \tag{14}$$

Example 3: Let {*a*, *b*, *c*, *d*} = {100, 150, 200, 250} (3-digit numbers, and including 0 in *S*). Using FD template and {*X*, *Y*} = {18, 15}

$$M_{FD} = \begin{bmatrix} \mathbf{100} & 298 & 135 & 167 \\ 230 & \mathbf{150} & 235 & 085 \\ 187 & 115 & \mathbf{200} & 198 \\ 183 & 137 & 130 & \mathbf{250} \end{bmatrix}. \quad (15)$$

Example 4: Let {*a, b, c, d*} = are randomly located as shown in Equation (15). Following the same general procedure, the template is

$$T_r = \begin{bmatrix} a+X & \boldsymbol{b} & c+Y & d-X-Y \\ \boldsymbol{d} & c-2X-Y & b+Y & a+2X \\ b-2X & \boldsymbol{a} & d+2X & \boldsymbol{c} \\ c+X & d+2X+Y & a-2X-2Y & b-X+Y \end{bmatrix} \quad (16)$$

Taking {*X, Y*} = {5, -7}

$$MS_r = \begin{bmatrix} 27 & \mathbf{12} & 11 & 89 \\ \mathbf{87} & 15 & 05 & 32 \\ 02 & \mathbf{22} & 97 & \mathbf{18} \\ 23 & 90 & 26 & 00 \end{bmatrix}. \quad (17)$$

3. Applications

3.1 Extensions of the method

The method is general and is applicable to any SQ, such as birthdate. One can choose a fixed but valid value for *X* (*Y*), and get various squares by varying *Y* (*X*) alone. However, a single square is good enough, unless one has some particular requirement. These squares can be used for decorating tiles, wall papers, screen, sending birthday wish, etc.

3.2 Deriving MSs for different *S*

Example 4: An MS of *S* = 257 is obtained by adding 156 in S41, S33, S24 and S12 (i.e., one number in each row but in different column) in MS of *S* = 101 of Equation (13). This is shown as $T_{CSp(S=257)}$ in Equation (17). The one viral on social media shown as $T_{CSv(S=257)}$ has 007 duplicated [4]. One may conclude from the demonstration of the video that *S* is restricted to 3 digits, none can be zero.

$$T_{CSp(S=257)} = \begin{bmatrix} \mathbf{029} & 200 & 013 & 015 \\ \mathbf{010} & 012 & 032 & 201 \\ \mathbf{019} & 011 & 202 & 025 \\ \mathbf{199} & 034 & 010 & 014 \end{bmatrix}, \; T_{CSv(S=257)} = \begin{bmatrix} \mathbf{007} & 197 & 042 & 011 \\ 012 & 041 & 200 & 004 \\ 201 & 009 & \mathbf{007} & 040 \\ 037 & 010 & 008 & 202 \end{bmatrix}. \quad (18)$$

3.3 MS from a specified *S*

Example 5: Any magic constant can be expressed in several ways as a sum of 4 DNN numbers. When *S* = 101 is expressed as {29 + 10 + 19 + 43}, MS is obtained from C1 template and {*X, Y*} = {1, 2} and shown in Equation (13). One more realization is given in Equation (18) when it is expressed as {29 + 19 + 10 + 43} using CS template and *X* = 5 and *Y* = 8.

$$T_{CS} = \begin{bmatrix} 15 & 27 & 34 & 25 \\ 33 & \mathbf{29} & \mathbf{19} & 20 \\ 06 & \mathbf{10} & \mathbf{43} & 42 \\ 47 & 35 & 05 & 14 \end{bmatrix}. \quad (19)$$

V. CONCLUSION

Two basic templates for different specified locations of 4 numbers are derived. However, these has repeated numbers. These templates are modified by adding and subtracting suitable values of only two variables. A MS of magic constant, *S* + *n*, is obtained from that of magic constant *S*. Applications of these templates are mentioned. A large number of MSs can be obtained from any specified magic constant.

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