Morse Code Cube Design

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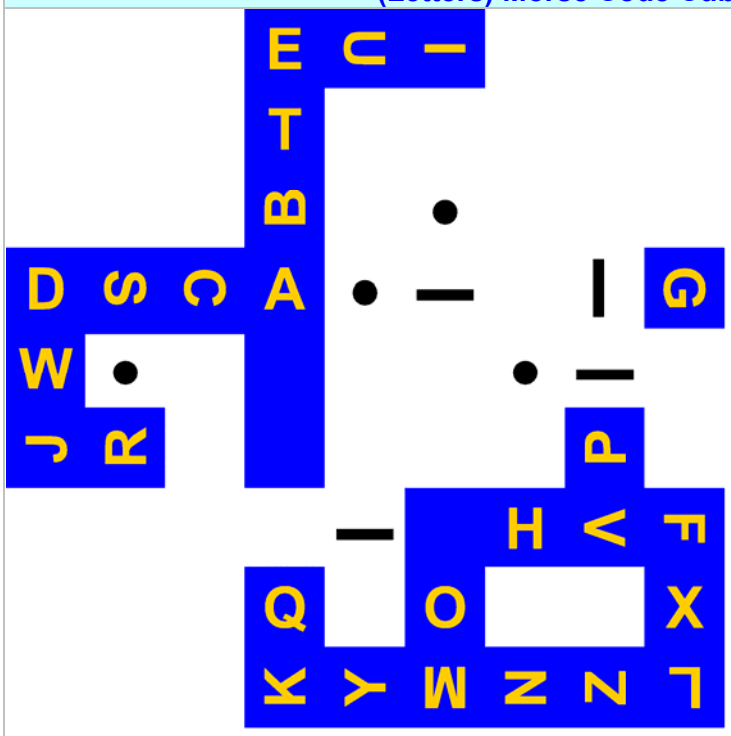
WebSites	http://www.mementoslangues.fr/	http://www.randelshofer.ch/

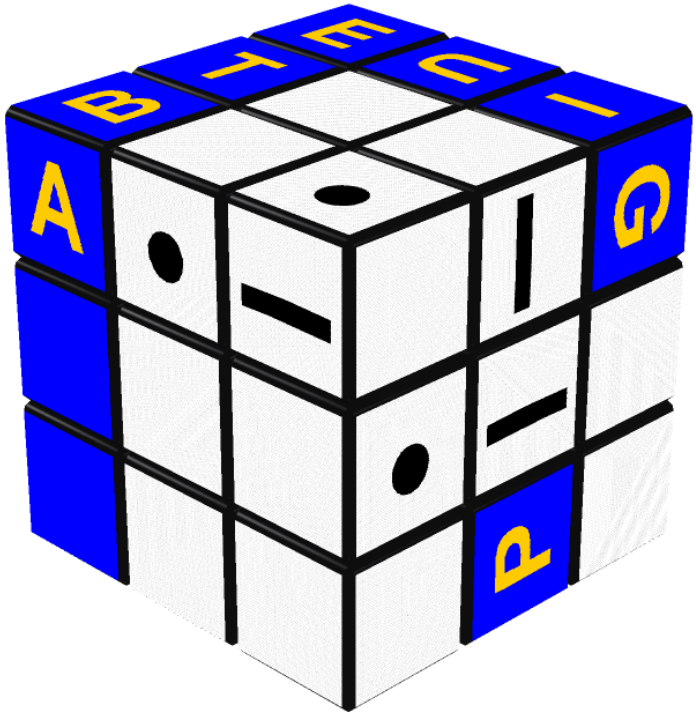
Introduction

Morse Code Cubes are 3x3x3 **Rubik's Cubes** used to display the Morse code of *all* 26 International Alphabet letters and the Morse code of *all* 10 first numbers.

(Letters) Morse Code Cube showing the code for 'A'

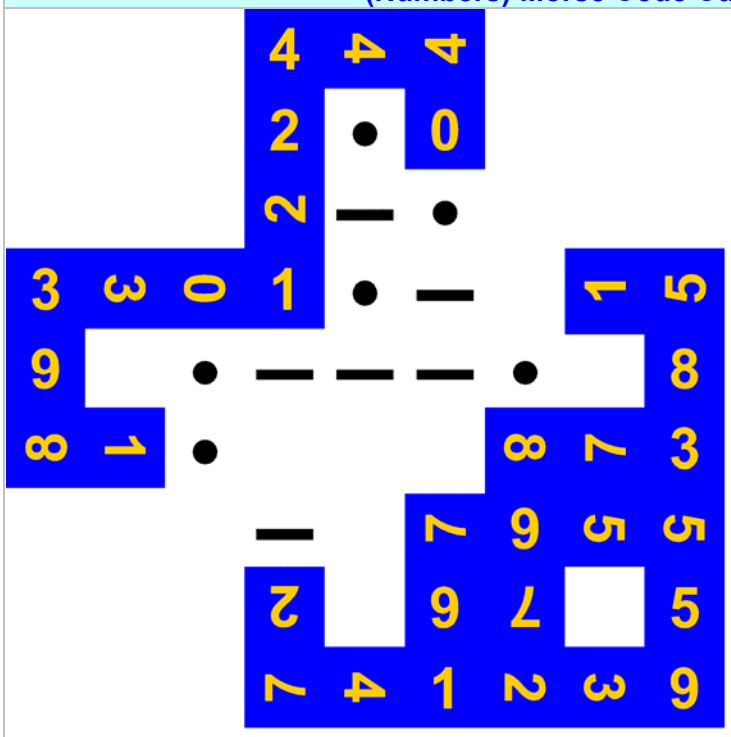


Morse Code Cube Texture – Letters

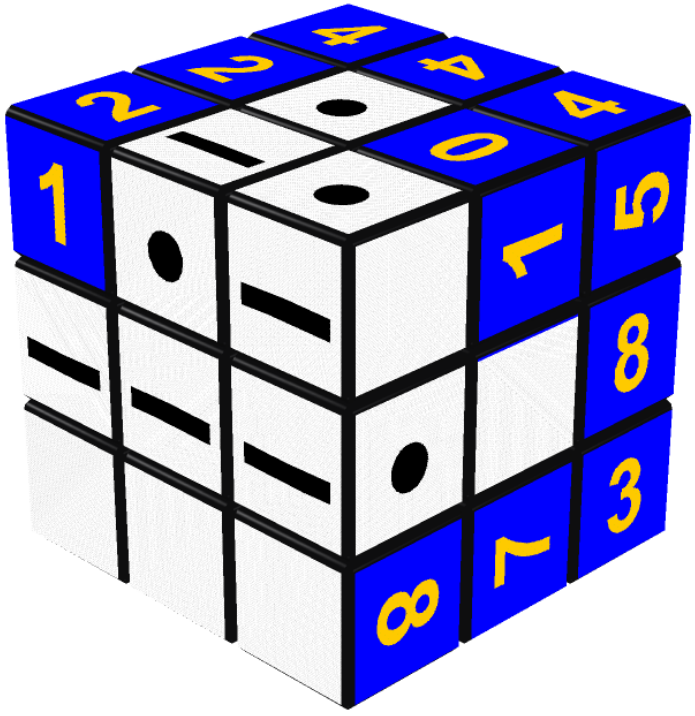


Letters Morse Code Cube – Letters

(Numbers) Morse Code Cube showing the code for '1'



Morse Code Cube Texture – Numbers



Numbers Morse Code Cube – Numbers

Download **CubeTwister** from: http://www.randelshofer.ch/

There are **Virtual Cubes** that can be *virtually* rotated and twisted on a computer screen and **Real Cubes** that can only be *physically* rotated and twisted by hand. A **Texture** is laid down on a Virtual Cube whereas real **Stickers** are stuck down on a Real Cube. A Morse Code Cube is designed by placing letters and numbers on a texture which is then laid down on a Virtual Cube (see http://www.randelshofer.ch/ for more details).

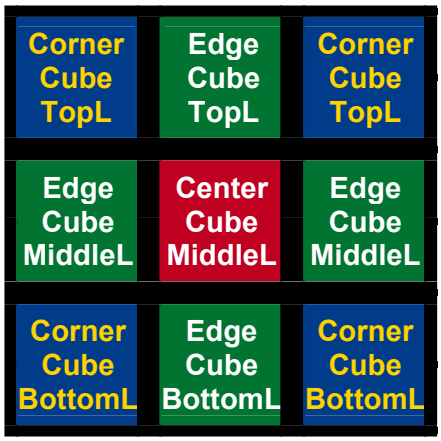
Morse code is a character encoding for transmitting telegraphic information, using standardized sequences of short and long elements to represent the letters, numerals, punctuation and special characters of a given message. The short and long elements can be formed by sounds, marks or pulses, in on off keying and are commonly known as "dots" and "dashes" or "dits" and "dahs" (see http://en.wikipedia.org/wiki/Morse_code).

The Morse code of *any* alphabet letter can be displayed on a *selected* Cube face by rotating and twisting some parts of the Cube. Similarly, the Morse code of *any* of all 10 first numbers can also be displayed on a companion cube. When this has been achieved, we say that the Cube has been *solved*

Designing a Morse Code Cube that *works* is definitely not a trivial task but **Design Rules** exist that should be applied. Because it is nearly impossible to test all configurations, the placement of numbers and letters on a texture should be carefully checked at *the end* of the design process. This is carried out by applying a **Design Rules Check** (**DRC**) in the final design stage.

Terminology

In a 3x3x3 **Rubik's Cube**, there are 8 *Corner Cubes*, 12 *Edge Cubes*, 6 *Center Cubes* and 6 *Cube Faces*. There are also 4 Corner Cube faces, 4 Edge Cube faces and 1 Center Cube face *per Cube Face*, as shown below.



There are 1 face per Center Cube, 2 faces per Edge Cube and 3 faces per Corner Cube.

There are also 3 horizontal *Layers* called *Top*, *Middle* and *Bottom Layers*.

Cube Lexicon		
English	**Français**	**Deutsch**
Cube	Cube	Würfel
cubie, cube	cube, petit cube	Würfelteil, Teil des Würfels
face	face	Seite, Seitenfläche
front face	face avant	vordere Seite, vorne
back face	face arrière	hintere Seite, hinten
left face	face gauche	linke Seite, links
right face	face droite	rechte Seite, rechts
top face	face supérieure	obere Seite, oben
bottom face	face inférieure	untere Seite, unten
sticker	étiquette (autocollante), plaquette	Kleber, Farbkleber
tile	tuile, plaquette	Plättchen, Farbplättchen
center cube, center	cube central, centre	Mittelwürfel, Mittelstein, Mitte
edge cube, edge	cube-arête, arête	Kantenwürfel, Kantenstein, Kante
corner cube, corner	cube de coin, coin	Eckwürfel, Eckstein, Ecke
layer	couronne	Schicht, Scheibe
top layer	couronne supérieure	obere Schicht, obere Scheibe
middle layer	couronne intermédiaire	mittlere Schicht, mittlere Scheibe, Mittelschicht, Mittelscheibe
bottom layer	couronne inférieure	untere Schicht, untere Scheibe
orientation, direction	orientation	Orientierung
to solve	résoudre	lösen, zusammen drehen
to twist	pivoter	drehen
to rotate	tourner, effectuer une rotation	drehen
clockwise	dans le sens horaire	im Uhrzeigersinn
anticlockwise, counter-clockwise	dans le sens anti-horaire	im Gegenuhrzeigersinn

Morse Code

International Alphabet	Letters	Morse Code	Numbers	Morse Code
ALPHA	A	• —	1	• — — — —
BRAVO	B	— • • •	2	• • — — —
CHARLIE	C	— • — •	3	• • • — —
DELTA	D	— • •	4	• • • • —
ECHO	E	•	5	• • • • •
FOXTROT	F	• • — •	6	— • • • •
GOLF	G	— — •	7	— — • • •
HOTEL	H	• • • •	8	— — — • •
INDIA	I	• •	9	— — — — •
JULIET	J	• — — —	0	— — — — —
KILO	K	— • —		
LIMA	L	• — • •		
MIKE	M	— —		
NOVEMBER	N	— •		
OSCAR	O	— — —		
PAPA	P	• — — •		
QUEBEC	Q	— — • —		
ROMEO	R	• — •		
SIERRA	S	• • •		
TANGO	T	—		
UNIFORM	U	• • —		
VICTOR	V	• • • —		
WHISKEY	W	• — —		
X-RAY	X	— • • —		
YANKEE	Y	— • — —		
ZOULOU	Z	— — • •		

Letters Morse Code Cube Layout

There are 26 letters in the International Alphabet and only 24 faces on the 8 corner cubes of a 3x3x3 Cube. So, letters have to be distributed *both* on corner and edge cubes.

En Bloc Layout Design

In this *particular* design, the left-hand side column is used for displaying letters either on a **T**op **L**eft (**TL**) corner cube or on a **M**iddle **L**eft (**ML**) edge cube. Morse Code symbols can then be displayed on one of two 4-faces *blocks*:

1- Block 1: symbols on **T**op **C**enter, **T**op **R**ight, **M**iddle **C**enter, **M**iddle **R**ight
2- Block 2: symbols on **M**iddle **C**enter, **M**iddle **L**eft, **B**ottom **C**enter, **B**ottom **R**ight

Alphabet letters are encoded as sequences which are composed of 1, 2, 3 or 4 symbols. Note that a sequence *never* begins with a 'white'. Then, a sequence is just a block of 4 symbols (symbol1,symbol2,symbol3,symbol4), arranged in a 2x2 table in order to be laid on a Cube Face. A block can then be **moved up or down** on a Cube Front Face.

***En Bloc* Symbols Layout**	
Symbol1 (●,▬)	Symbol2 (●,▬,white)
Symbol3 (●,▬,white)	Symbol4 (●,▬,white)

Center Cubes Layout

There are only 2 symbols laid on 2 center cubes: '●' (dot) and '▬' (dash) but there **must** be a 'white" center cube.

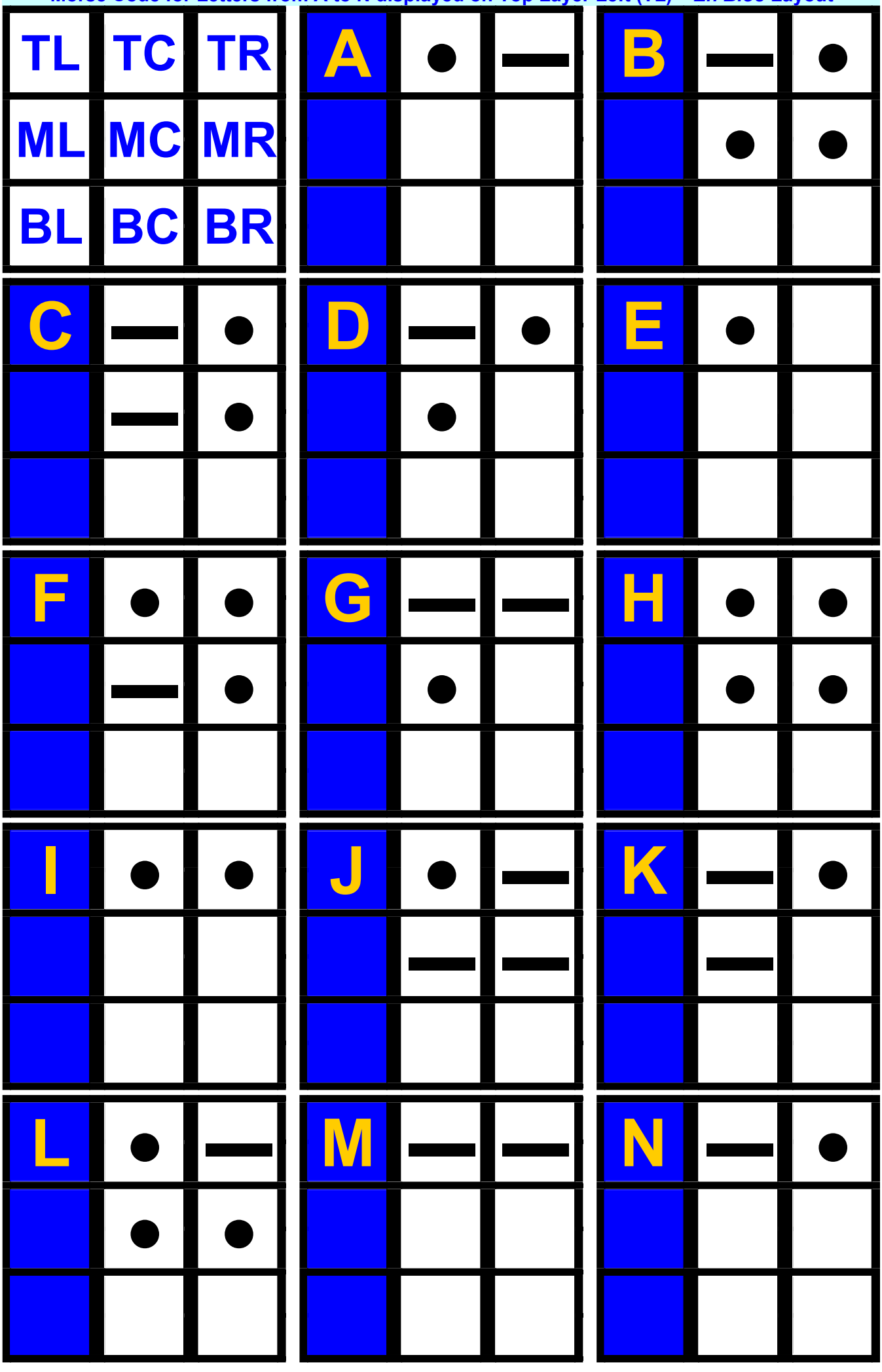
Corner Cubes Layout

1- 5 corner cubes for 14 letters from A to N that are *logically* grouped and laid out **T**op **L**eft (**TL**):
(A,B,C), (D,E,F), (G,H,I), (J,K,L), (M,N,white)
2- 1 corner cube for symbols:
(●,▬,white)
3- 1 corner cube with one blue face:
(blue,white,white)
4- 1 corner cube with one blue face:
(blue,white,white)

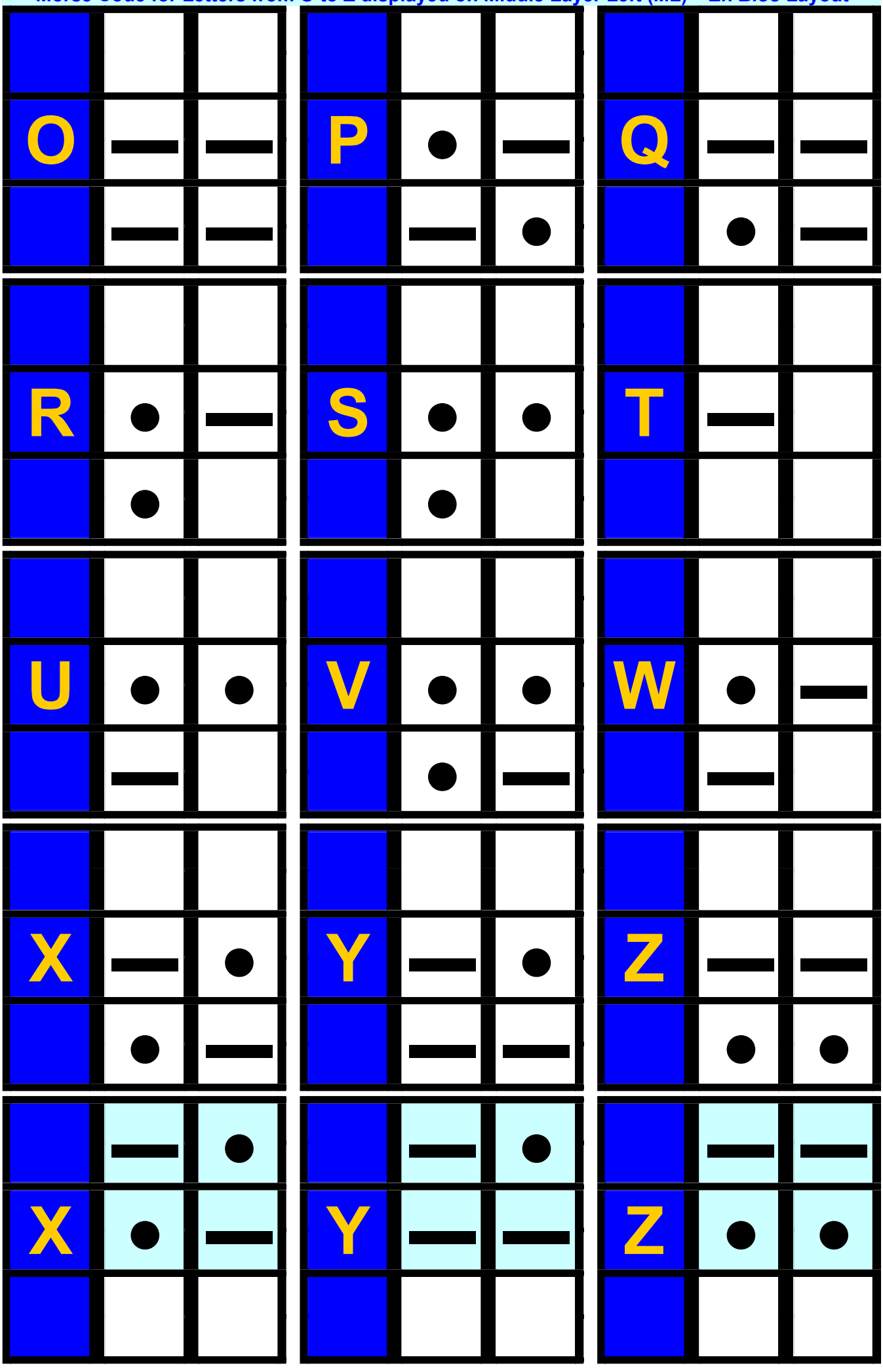
Edge Cubes Layout

1- 6 edge cubes for the remaining 12 letters that are *logically* grouped and laid out **M**iddle **L**eft (**ML**)
(O,P), (Q,R), (S,T), (U,V), (W,X), (Y,Z)
2- 4 edge cubes for symbols:
(●,white), (●,white), (▬,white), (▬(90°),white)
3- 1 edge cube with one blue face:
(blue,white)
4- 1 blank edge cube:
(white,white)

Morse Code for Letters from A to N displayed on Top Layer Left (TL) – *En Bloc* Layout



Morse Code for Letters from O to Z displayed on Middle Layer Left (ML) – *En Bloc* Layout



Numbers Morse Code Cube Layout

There are 10 numbers that should be distributed on the cube. For maximizing *flexibility*, each of these 10 numbers *and* the associated Morse code can be displayed ***En Bloc*** with up to **4 configurations per number**. A block can be **moved up or down** on a Cube Front Face.

En Bloc Layout Design

Numbers are encoded as sequences which are composed of 5 symbols. Then, a sequence is just a block of 5 symbols (symbol1,symbol2,symbol3,symbol4,symbol5) *plus* the number, arranged in a 2x3 table in order to be laid on a Cube Face.

***En Bloc* Symbols Layout**					
Number on the Right			**Number on the Left**		
Number	Symbol1 (●,—)	Symbol2 (●,—)	Symbol1 (●,—)	Symbol2 (●,—)	Symbol3 (●,—)
Symbol3 (●,—)	Symbol4 (●,—)	Symbol5 (●,—)	Symbol4 (●,—)	Symbol5 (●,—)	Number

Center Cubes Layout

There are only 2 symbols laid on 2 center cubes: '●' (dot) and '—' (dash).

Corner Cubes Layout

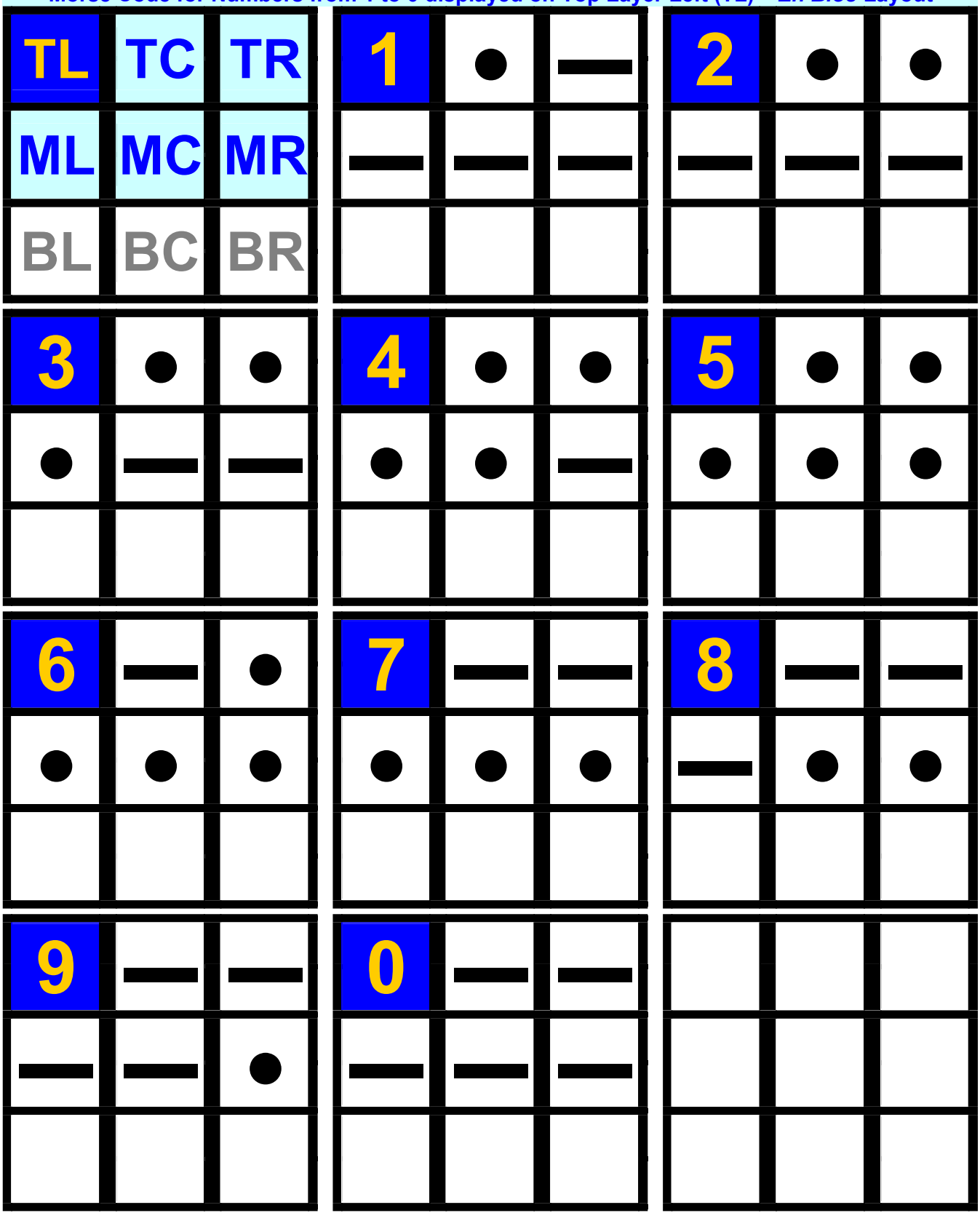
1- 3 corner cubes for 10 numbers that are *logically* grouped and laid out **T**op **L**eft (**TL**):
(0,1,2), (3,4,5), (6,7,8), 9 (9 is a 6 from a **BR** corner)
2- 3 corner cubes for 10 numbers that are *logically* grouped and laid out **B**ottom **R**ight (**BR**):
(1,2,3), (4,5,6), (7,8,white), 0 (0 is a 0 from a **TL** corner), 9 (9 is a 6 from a **TL** corner)
3- 2 corner cube for symbols:
(●,—(**TL**),white), (●,—(**TR**),white)

Edge Cubes Layout

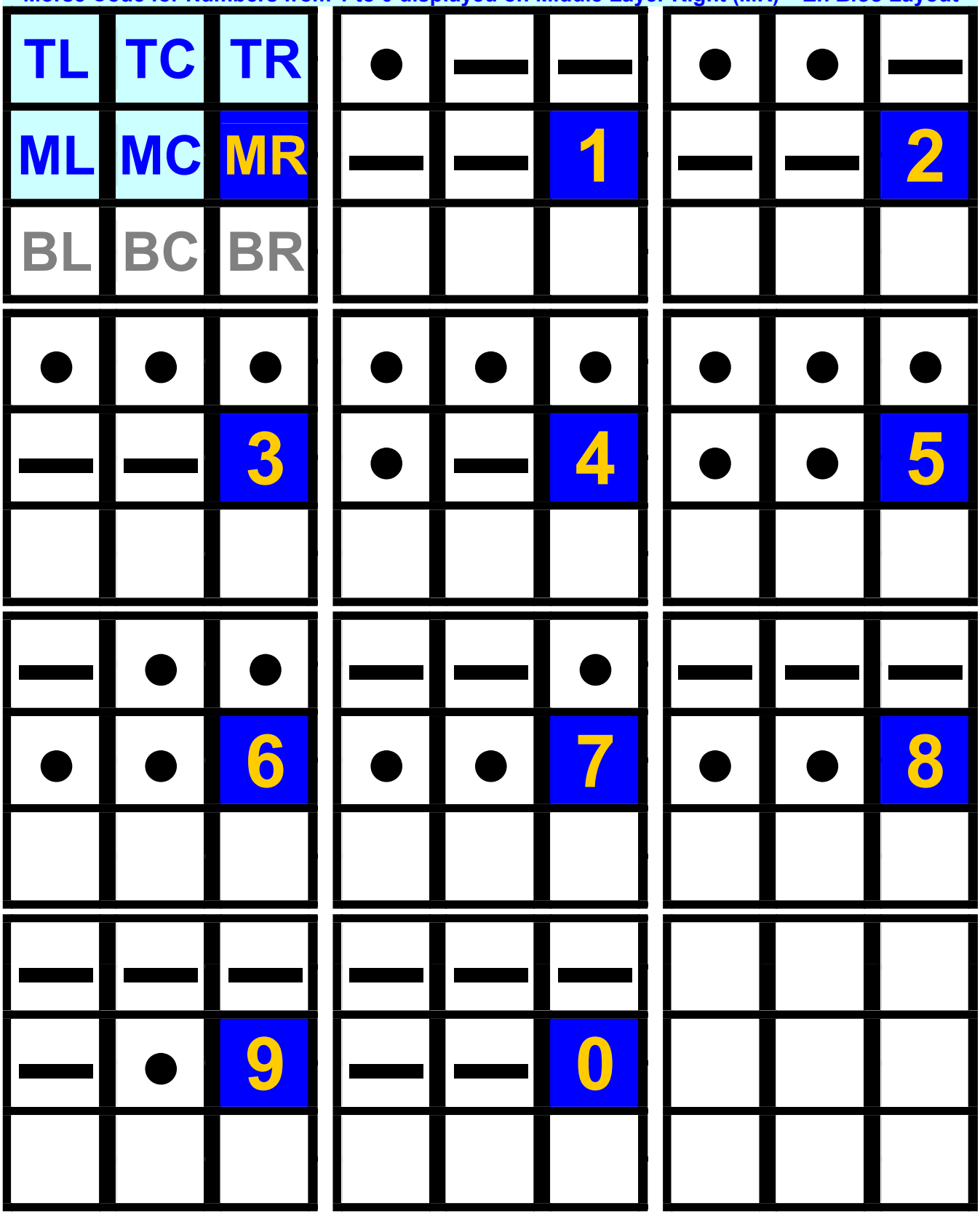
1- 4 edge cubes for 10 numbers are *logically* grouped and laid out **M**iddle **L**eft (**ML**)
(0,1), (2,3), (4,5), (6,7), 8* (8 is an 8 from an **MR** edge), 9 (9 is a 6 from an **MR** edge)
2- 4 edge cubes for 10 numbers are *logically* grouped and laid out **M**iddle **R**eft (**MR**)
(1,2), (3,4), (5,6), (7,8), 0 (0 is a 0 from an **ML** edge), 9 (9 is a 6 from an **ML** edge)
3- 3 edge cubes for symbols:
(●,—(**ML/MR**)), (●,—(**ML/MR**)), (●,—(**TC/BC**))
4- 1 white edge cube
(white,white)

* An '8' is composed of 2 loops, the upper loop being usually smaller than the lower loop. If an '8' is to be used flipped over (ie. 180° rotated), *it should be redrawn* with both loops of the *same* dimensions.

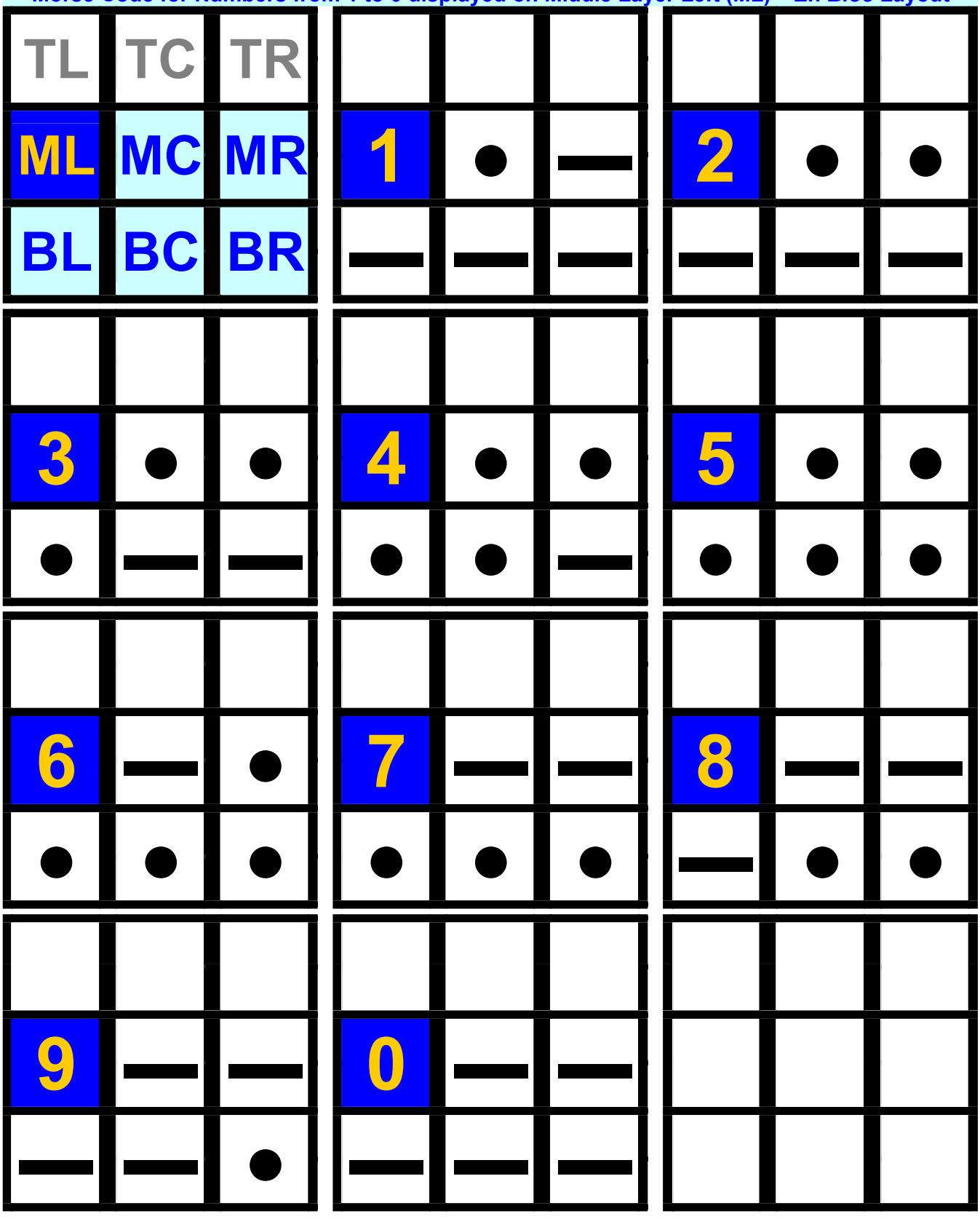
Morse Code for Numbers from 1 to 0 displayed on Top Layer Left (TL) – *En Bloc* Layout



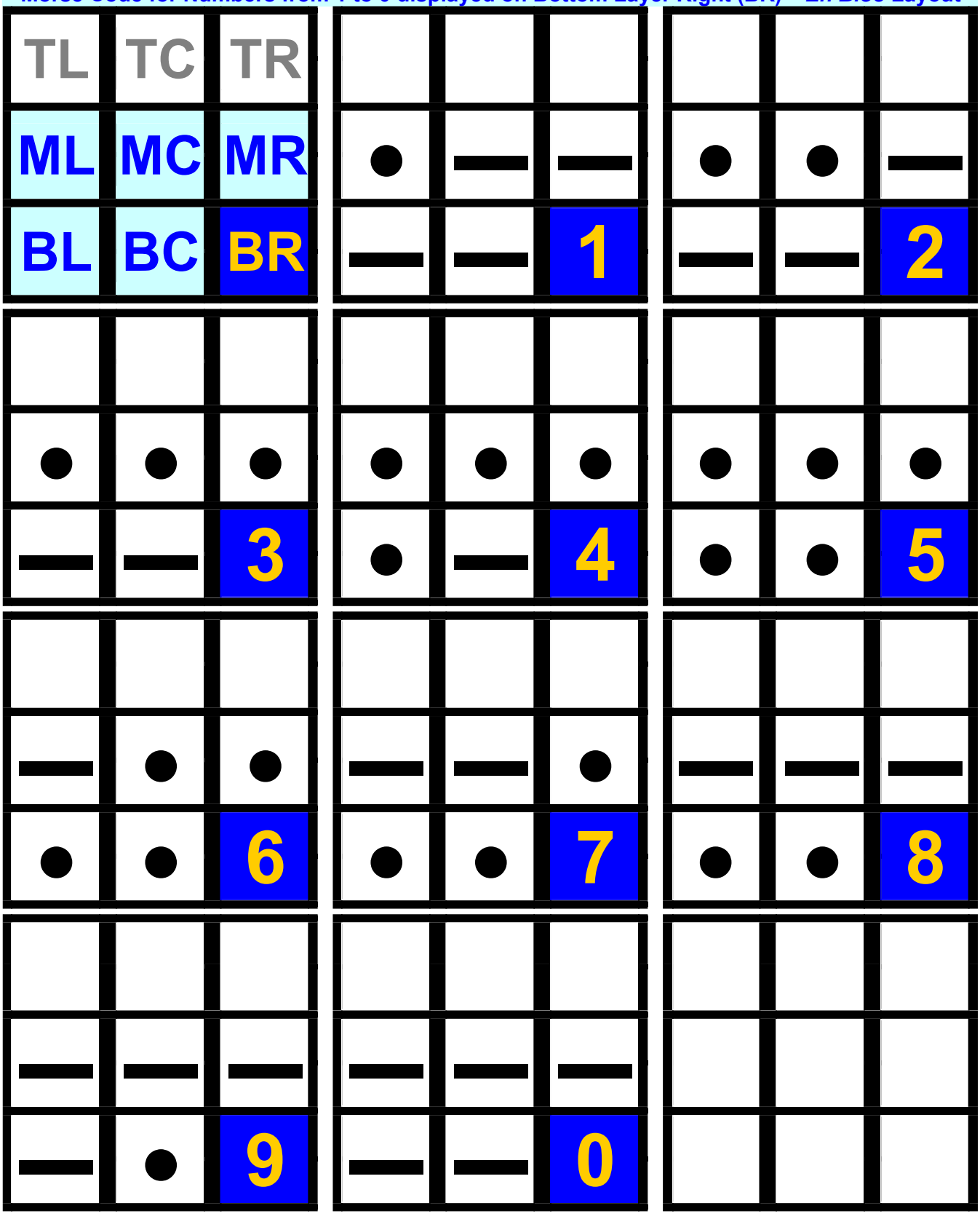
Morse Code for Numbers from 1 to 0 displayed on Middle Layer Right (MR) – *En Bloc* Layout



Morse Code for Numbers from 1 to 0 displayed on Middle Layer Left (ML) – *En Bloc* Layout



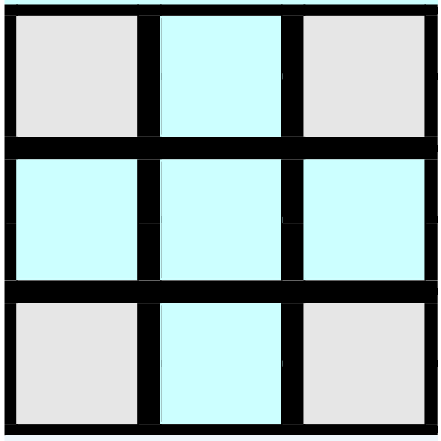
Morse Code for Numbers from 1 to 0 displayed on Bottom Layer Right (BR) – *En Bloc* Layout



Solving a Letters Morse Code Cube Step by Step

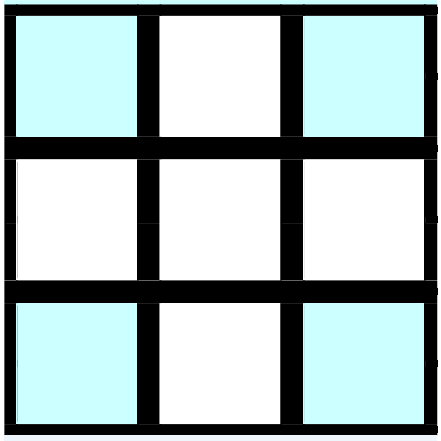
In this example, a step by step solving process is applied to the Morse Code Cube, just described before. Note that we only need to solve a *single* Face out of six. We will solve a Face for letter '**C**'.

Solve the Cross First



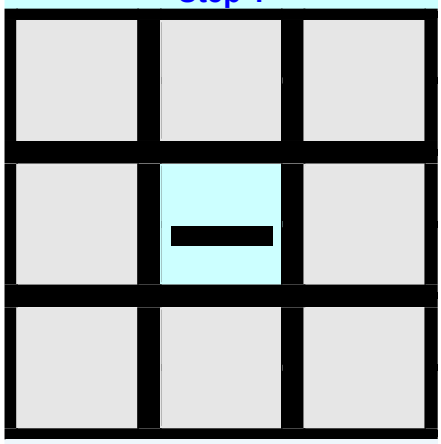
Standard Rubik's Cube Solving

Then Solve the Corner Cubes



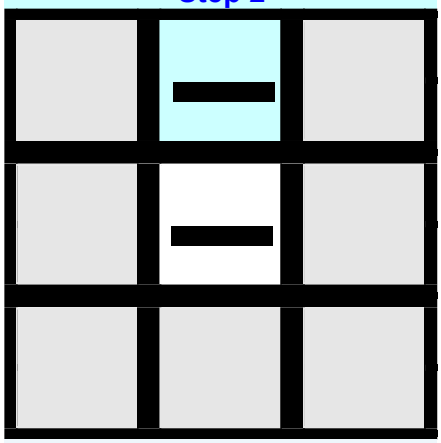
Standard Rubik's Cube Solving

Step 1



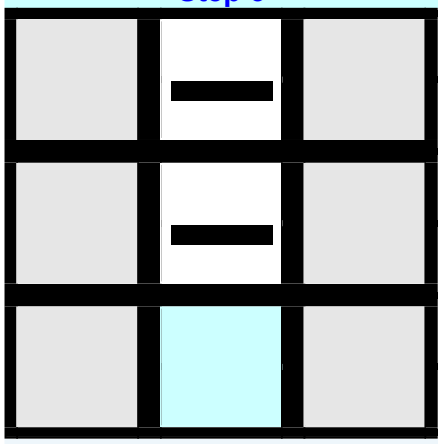
Center Cube — on Front Face

Step 2



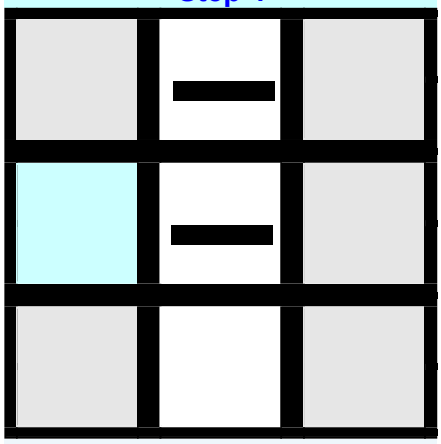
Top Layer: Edge Cube —

Step 3



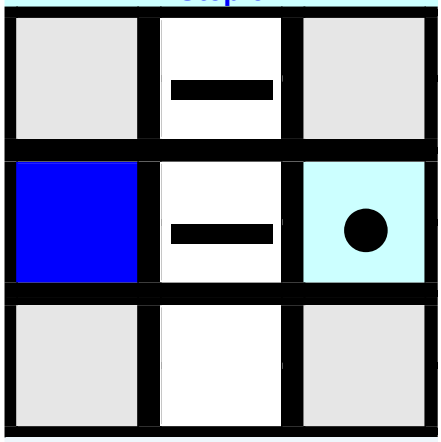
Bottom Layer: Edge Cube **White**

Step 4



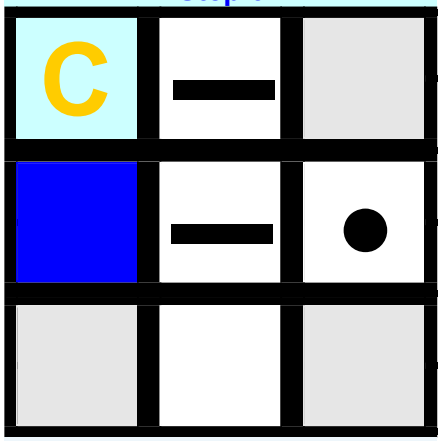
Middle Layer: Edge Cube **Blue**

Step 5



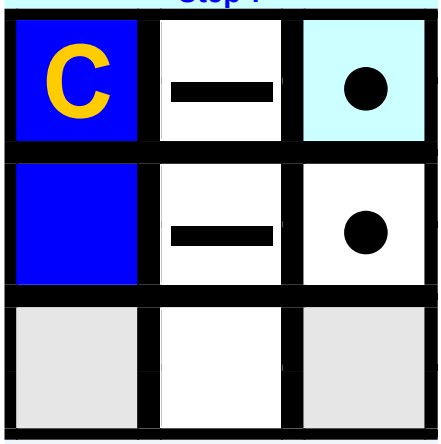
Middle Layer: Edge Cube ●

Step 6



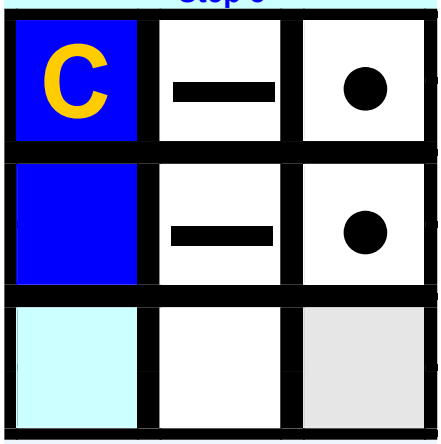
Top Layer: Corner Cube C

Step 7



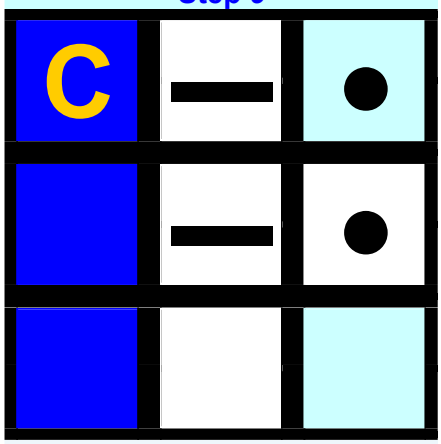
Top Layer: Corner Cube ●

Step 8



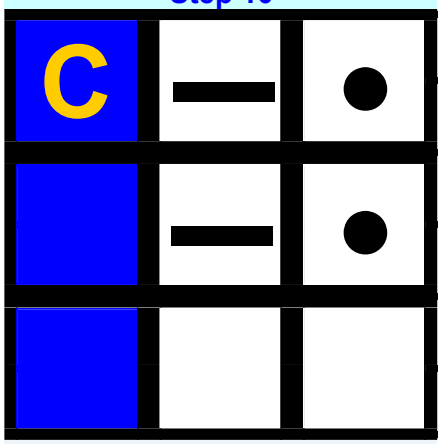
Bottom Layer: Corner Cube **Blue**

Step 9



Bottom Layer: Corner **White**

Step 10



That's it !

Print out this page and fill in the blank faces with *your* data. Then try to design your *own* Cube.

TL	TC	TR
ML	MC	MR
BL	BC	BR

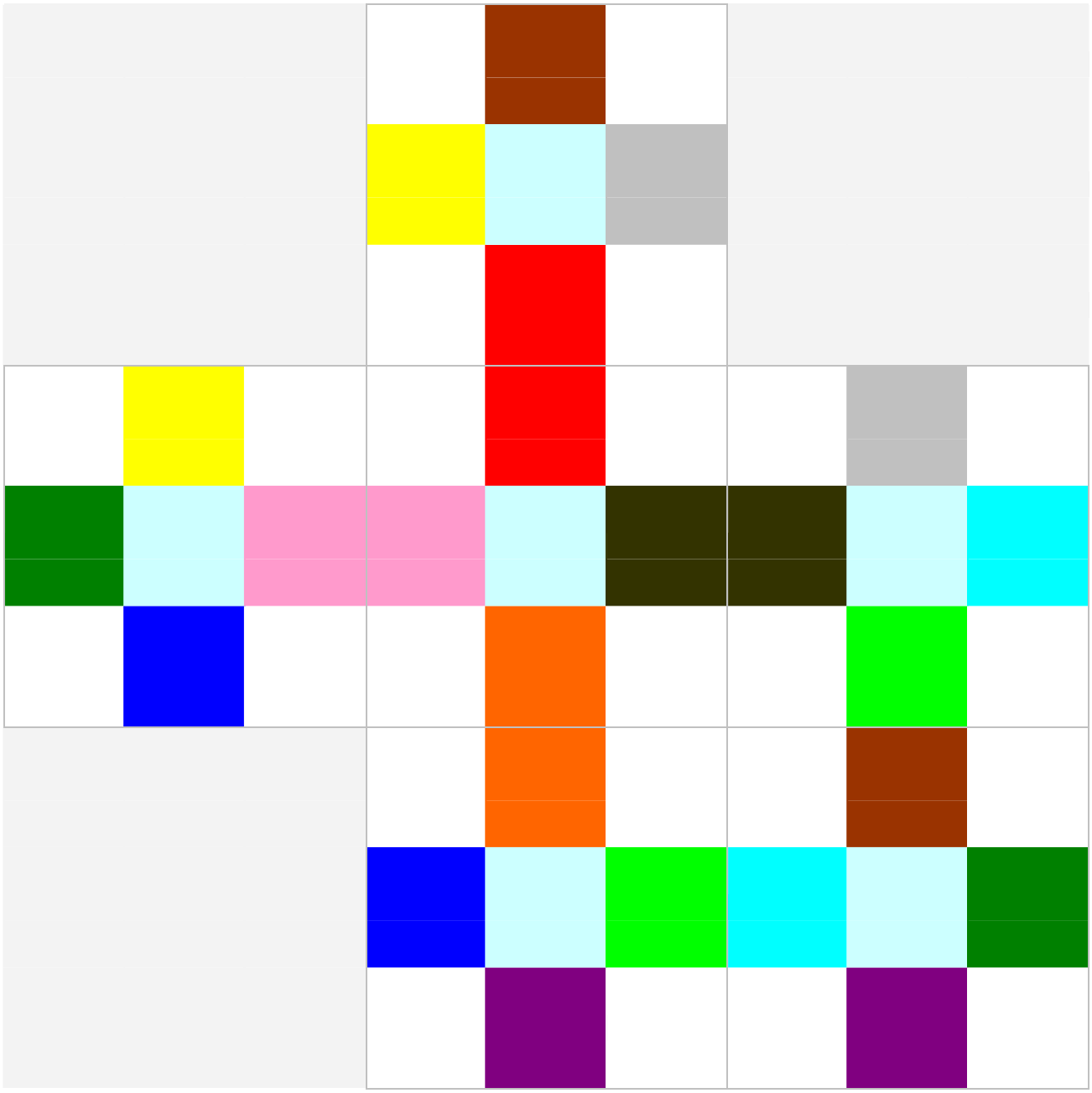
Corner Cubes Final Check

There are 8 Corner Cubes and 3 faces per Corner Cube. In the diagram below, each Corner Cube is displayed in 8 different colors and with the same color applied to each of its 3 faces. This diagram can be used as a convenient *visual aid* to check Design Rules (DRC).

	Up		
Left	**F**ront	**R**ight	**B**ack
	Down	**B**ack	

Edge Cubes Final Check

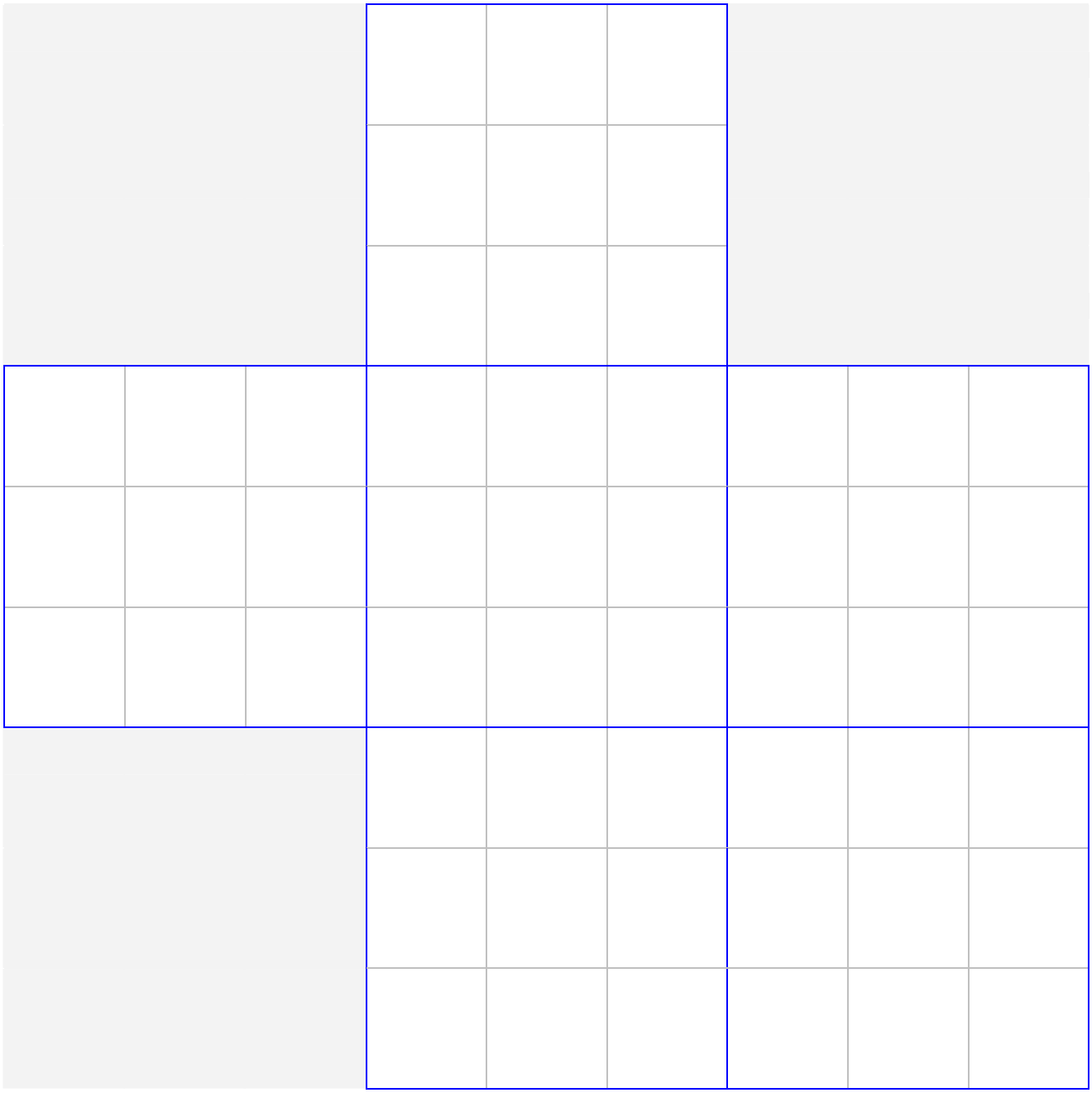
There are 12 Edge Cubes and 2 faces per Edge Cube. In the diagram below, each Edge Cube is displayed in 12 different colors and with the same color applied to each of its 2 faces. This diagram can be used as a convenient *visual aid* to check Design Rules (DRC).



	Up		
Left	**F**ront	**R**ight	**B**ack
	Down	**B**ack	

Texture Template

This is a texture template that can be printed out and used for writing down numbers and letters by hand *prior to* texture design. All is needed are pencil, rubber…and time.



	Up		
Left	**F**ront	**R**ight	**B**ack
	Down	**B**ack	