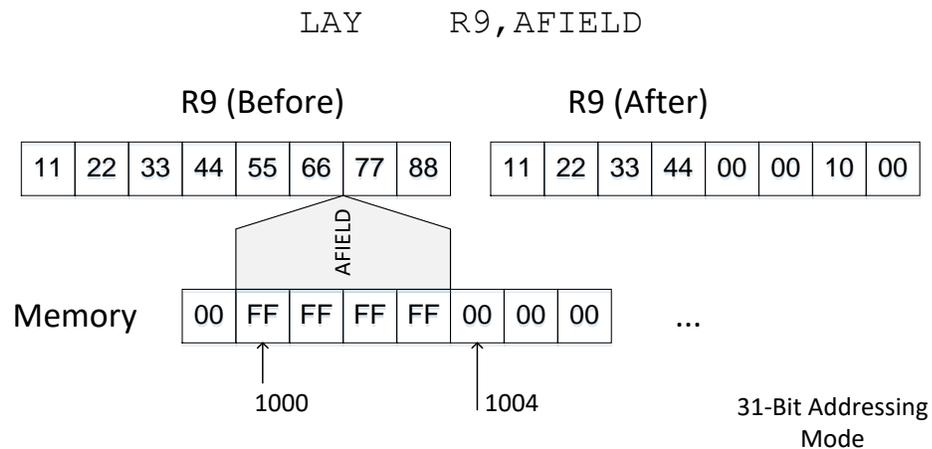


LAY is used to initialize the register specified by operand 1 with the address designated by operand 2. The number of bits that are loaded can be 24, 31, or 64 depending on the addressing mode. Operand 2 may be expressed using explicit notation or symbolic notation, or a combination of both. Remember that each byte in memory is numbered and that the number assigned to a byte is its address. The address of a field is the address of the first byte of the field. Consider the following example,



The address of the fullword "AFIELD", x'00001000', is copied to register 9, destroying the previous value in R9. The fullword is unchanged by this operation. We are assuming a 31-bit addressing mode.

Since **LAY** is an RXY-A instruction, an index register may be coded as part of operand 2 as in the example below. We assume that register 6 is used as an index register and initially contains x'0000002F'. When the assembler processes the expression AFIELD(R6), it uses the symbol AFIELD to determine a base register and a displacement, leaving R6 as the index register. The address which is loaded into register 9 is the "effective address" computed by adding the base register contents, plus the index register contents, plus the displacement:

$$\text{Effective address} = C(\text{Base register}) + C(\text{Index register}) + \text{displacement}$$

We assume that the contents of the base register plus the displacement is x'00001000'. Then the effective address is x'00001000' + x'0000002F' = x'0000102F'.

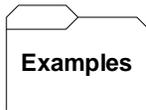
LAY R9, AFIELD (R6)

The example above uses a mixture of symbolic and explicit addressing. The instruction could also be coded using only explicit addresses:

```
LAY R9, 30 (R7, R8)
```

In the example above assume that R7 contains x'00001000' and that R8 contains x'00000020'. R7 is treated as an index register, R8 is the base register, and 30 is a displacement. The effective address is $C(R7) + C(R8) + 30 = x'00001000' + x'00000020' + x'0000001E' = x'0000103E'$. (Remember that a decimal 30 is 1E in hexadecimal.) After the instruction has executed, R9 contains x'0000103E'.

RXY-a instructions provide a 20-bit signed displacement in the base/displacement address for operand 2, while RX instructions provide a 12-bit displacement. As a result, when using **LAY**, the address of operand two can be from 0 to +524,287 bytes in front of base address for the corresponding base register, or from 1 to 524,288 bytes behind that location. This is a much larger range than the $2^{12} = 4,096$ byte (strictly positive) range provided by LA (Load Address).



Some Unrelated Load Addresses

```
R4 = X'12121212'  
R5 = X'00000008'  
R6 = X'00000004'
```

Assume that AFIELD has address x'00003000'.

```
AFIELD DC F'4' AFIELD = X'00000004'
```

```
LAY R4, AFIELD R4 = X'00003000'  
LAY R4, AFIELD(R6) R4 = X'00003004'  
LAY R4, AFIELD(R5) R4 = X'00003008'  
LAY R4, 20 (R5, R6) R4 = X'00000020' 4 + 8 + 20 = 32 = X'20'
```

Using R0 as an index indicates that no index register is desired:

```
LAY R4, 3 (R0, R6) R4 = X'00000007' 4 + 3 = 7
```

Consider the next two consecutively executed instructions.

```
LAY R4, AFIELD R4 = X'00003000'  
LAY R4, L' AFIELD (R0, R4) R4 = x'00003004'
```

In the example above, the length attribute (L') is used as a displacement

Tips

1. An old assembler joke:

Novice: "What's the difference between a Load instruction and a Load Address instruction?"

Old Hand: "About a week of debugging."

Seriously, you should pay attention when coding **LY** or **LAY**. Both instructions compute the address of operand 2. In the case of **LY**, the machine retrieves the contents of the fullword in memory at the specified address and places the four bytes in a register. In the case of **LAY**, the address is simply stored in a register.