Example ; Designing employee parking Space

Example 4.1

A new facility is to have 200 employees. A survey of similar facilities indicates that one parking space must be provided for every two employees and that 40% of all automobiles driven to work are compact automobiles. Five percent of the spaces should be allocated for the handicapped. The available parking lot space is 180 feet wide and 200 feet deep. Assuming no walls and no walking edge, determine the best parking layout using SW of 8'-6" for standard cars.

If the new facility were to have the same number of parking spaces as similar facilities, 100 spaces would be required. Of these 100 spaces, 40 could be for compact automobiles. However, not all drivers of compact cars will park in a compact space. Therefore, only 30 compact spaces will be provided. Begin the layout of the lot using 90° double-loaded, two-way traffic because of its efficient use of space to determine if the available lot is adequate. From Figure 4.2, W4 is the required module option. Using the W4 module and Table 4.1, we can obtain the following:

Compact cars (8'-0")	Module width
90°, W4	57'-2"
Standard cars (8'-6")	66'-0"
90°, W4	

200 employees

1 space ⟶ for 2 employees

40% ⟶ compact cars

5% ⟶ handicapped

W = 180 feet , D = 200 feet

avaliable Space =

$\left(\frac{180\ ft}{width} * \frac{200\ ft}{depth}\right)$

* no walls , no walking edgs.

* SW = 8'6" for standard.

1 First Steps Determine #of space to be required.

$200\ employees * \frac{1\ Parking}{2\ employees} = 100\ space\ required.$

⟶ 40% compact : $\frac{40}{100} * 100 = 40$ space for compact → 30 space for compact cars.

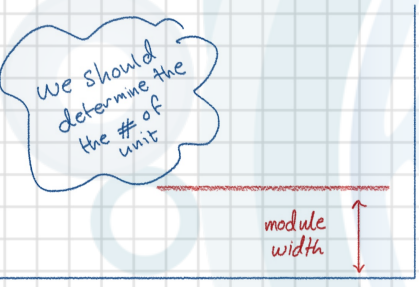
⟶ 5% handicapped = $\frac{5}{100} * 100 = 5$ space for handicapped.

2 Parking Layout :

W4, double-Loaded , 2 way traffic , 90° (efficient use of space). → using table (4.1).

best utilization.

* each unit or module should be for either compact or for standard.



- Types of car
  - compact
    - SW = 8'0" → * Module width.
      - should be found for compact = W4, 90°
      - = (57'2")
  - Standard. → Given (8'6"), W4, 90°
    - = (66'0").

3 Determine #of module for compact & #of module for standard.

[Check to see if the depth of (200ft) can accomodate a parking layout consisting of two module of standard & one module of compact].

$(2\ module * (66')) + (1 * (57'2")) = 189'2" < 200\ ft$

Best Option

compact

row — standard

row — standard

4 Determine # of unit or module for each type of cars (Design the layout).

each compact module row will yield car capacity based on the width requirement per stall (8')

for Standard : $2\ module * \frac{2\ rows}{module} * \left(\frac{180\ ft\ width}{8'6" = (8.5)'}\right) = 4 * (22.17) = 4 * 22 = 84$ potential for standard cars.

(8.5)' ← SW for standard.

22.17 ← we talk about space (always round down).

for compact cars : $1\ module * \frac{2\ rows}{module} * \left(\frac{180\ ft\ width}{8"}\right) = 2 * (22.5) = 2 * 22 = 44$ potential for compact car.

22.5 ← round down.

Total possible spaces = 44 + 84 = 128 > 100 (required #)

→ module configuration is visible ⇒ we can use it.

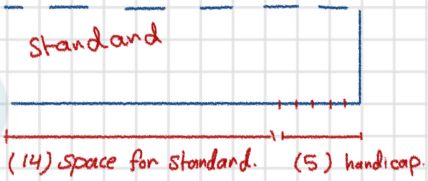
* The suggested layout $\frac{2 \text{ row}}{\text{module}}$ (2 standard module + 1 compact module) → 6 rows

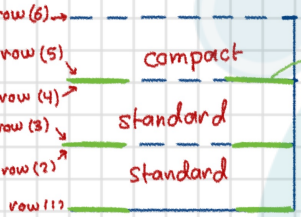
☒ modify the layout for handicap & circulation reveals : handicap in the module of standard car.

⇒ 5% = 5 spaces , SW = 12′

Space = $\frac{5 \text{ handicap}}{\text{cars}}$ × $\frac{12'}{\text{handi. car}}$ (only in the first row.) = 60′

→ remaining space = $\frac{180' - 60'}{8.5'}$ = 14 spaces.





Lanes = 15′ Both sided

for circulation :

* for the second row in the standard module :

# of standard car = $\frac{180 - (15' \times 2)}{8.5}$ (both sided) = 17 spaces for standard cars. for row (2)

↳ standard car

for row (3), row (4). : no handicap ⇒ so it's 17 space for standard car

for row (5) : $\frac{180 - (15' * 2)}{8}$ = 18 spaces for compact cars.

for row (6) : $\frac{180}{8}$ = 22 spaces for compact cars.

width for aisle = (15′ * 2)

Slide 2w, 4c

Angular parking

Example 4.2

Using the same data given for Example 4.1, let us compute the number of standard car stalls that can be placed along the module depth, assuming a stall depth of 16 feet (SD = 16′) and a parking angle of 60 degrees (θ = 60). Before we compute the above number, it is instructive to compare the module widths. With 90° parking under option W4, earlier we obtained a module width of 66′-0″ from Table 4.1 for standard cars. With 60° parking, however, from Table 4.1, we obtain 51′-8″ for the module width for standard cars. Hence, parking at an angle reduced the module width by more than 14 feet, which is a positive outcome (since it may allow us to place more modules in a given lot). However, as we next show, the number of stalls per module decreases when the parking angle is reduced from 90° to 60°.

We first compute the parking width (PW). Recall that PW = SW/sine θ. That is, PW = 8.5/sine 60 = 9.8′. In reference to Figure 4.4, we next compute the value of *y*, which represents the distance lost due to parking at an angle.

using same data from Ex(4.1).

200 employees

1 space ⟶ for 2 employees

40% ⟶ compact cars

5% ⟶ handicapped

W = 180 feet , D = 200 feet

available Space =

$\left(\frac{180\ ft}{width} * \frac{200\ ft}{depth}\right)$

+ no walls, no walking edgs.

SW = 8′6″ for standard.

Assume a stall depth = 16 ft , & parking angle = 60°

Solu : * 100 parking space
40 compact cars ⟹ 80 compact cars.

* Compact module width. → for 60° = 42′9″

for 90° (standard car , W4) ⟶ 66′ 0″

for 60° (standard car , W4) ⟶ 51′8″ ← less module width.

So parking at angle reduce the module width

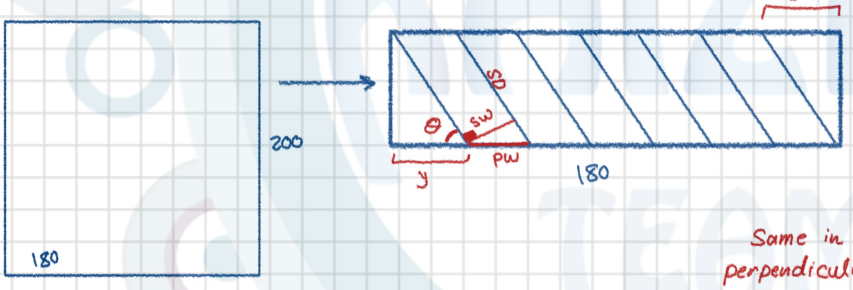
66′ − (51 + 0.666) ⟹ 66′ − 51.5′ = 14.5 (diff.)

(+) out come

So we will have more module

could 51.667 * 3 = 155
+ 42.75
197 ⟶ could be done.

[2] Determine # of space (stall) per module



y = Distance lost due to parking at an angle ; ↳ zero at angle 90° **

θ = parking angle

SD = stall depth ⟶ = 16′ in this question.

Same in the perpendicular parking (90°)

SW = stall width ⟶ = 8′6″ given in this question

PW = parking width ⟶ $\sin\theta = \frac{SW}{PW}$

** $PW = \frac{(8.5)'}{\sin(60)} = 9.8'$ --- ⊛

find (y) = $\cos\theta = \frac{y}{SD}$ ⟹ $y = \cos\theta * SD$.

$y = \cos(60) * 16 = 8'$ .... ⊛

* Since the parking width = 180′

module width ⟹ y + (# of stall * PW)

180 = 8 + (# of stall * 9.8′).

⟹ # of stall = 17.55 stalls
↳ 17 stalls
↳ always round down.

for 90° ⟹ $\frac{180}{8.5} = 21.7 = 21$ space

* This means we have less stalls for angular parking per module but in angular parking we have more # of module.

Note :

parking at angle require aisle to be one way.

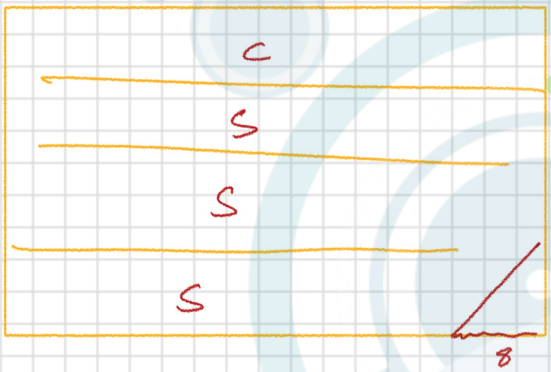
angular parking :

$\theta = 60$ → 2 standard, 2 compact ⟹ $\frac{180}{8.6} = 21.1 = (21 * 4) = 84$ (21 = per row, 4 = # of rows)

$\theta = 60$ → 3 module standard + 1 " compact] 19' width

for each row

5% handicapped in standard module first row



$y = 8ft$

handicapped → $\frac{12}{pw_{handicap}}$

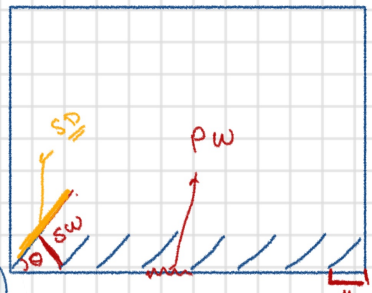
$\frac{12}{\sin 60} = 13.8'$

$pw_{standard} = \frac{8.5}{\sin\theta} = 9.8'$

$pw_{compact} = \frac{8}{\sin 60} = 9.2$

row (1) = $\frac{180 - 8 - (5 * 13.8)}{9.8} = 10.5 \Rightarrow$ 10 space

5 handicapp & 10 standard.



y: area lost due to parking at angle.

$\sin\theta = \frac{sw}{pw} \rightarrow \frac{8.5}{pw} = \sin\theta$

$pw = 9.8'$

② row 2, 3, 4, 5, 6

$\frac{180 - (15 * 2) - 8}{9.8} = 14.48 = 14$ space

for compact row 7 = $\frac{180 - 8 - 36}{9.2} = 15.4 = 15$

row 8 = $\frac{180 - 8}{9.2} = 18.6 = 18$ space.

Restrooms :

Table 4.2

SECTION 4.3

4.7 A facility is to house 50 female and 50 male employees. Using a 40% allowance for aisles and clearances, how much space should be planned for the restrooms?

Men 50

* Water Closets = $15\ ft^2 * 3 = 45\ ft^2$
* Lavatories = $6\ ft^2 * 3 = 18$
* Entrance = $15\ ft^2 * 1 = 15$
* Urinal = $6\ ft^2 * 1 = 6$

* Sub. total = $84\ ft^2$

Women 50

* Water Closets = $15\ ft^2 * 3 = 45$
* Lavatories = $6\ ft^2 * 3 = 18$
* Entrance = $15\ ft^2 * 1 = 15$
* bed or coach = $60\ ft^2 * 1 = 60$

1 bed & coach ← X<100
2 " ← 100<X<250

Subtotal = $138\ ft^2$

* 40% for allowance & clearance ⇝ $0.4 * 84\ ft^2 = 33.6$; $0.4 * 138\ ft^2 = 55.2$

tot = $117.6\ ft^2$; tot = 193.2

Health Services:

SECTION 4.5

2 nurses & one part-time physician

4.12 If two nurses and a part-time physician are to be employed in a health services area, how much space should be allowed in the facilities plan?

1. Waiting room ⟶ Depend on the # of nurses
2. First aid room ⟶ Depend on the # of nurses
3. Examination room ⟶ Depends on the physician

* waiting room with one nurse ⟶ $75\ ft^2$
* First aid room ⟶ $250\ ft^2$ per nurse.
* Additional in the waiting room ⟶ $25\ ft^2$ per nurse.
* Examination room ⟶ $150\ ft^2$

Total area = $100 + 500 + 150 = 750\ ft^2$

1 Waiting room

2 nurse, $75\ ft^2$ for the first nurse & 25 per additional.

$$75\ ft^2 + \left(1\ \text{nurse} \times \frac{25\ ft^2}{\text{nurse}}\right) = 100\ ft^2$$

2 First Aid room =

2 nurse, $250\ ft^2$ per nurse. $= 500\ ft^2$

3 Examination room:

one physician, $150\ ft^2$ per physician $= 150\ ft^2$

300 – 400 ⇒ parking
200 ⇒ restr. rooms
1000 ⇒ decen. food
200 water fount.

min space, health ⇒ $100\ ft^2$