Calculating School Capacity: Local, State & National Perspectives

CEFPJ Pre-Conference Workshop - October 6, 2007
workshop agenda

- **Introductions**
  - who & why
  - learning objectives

- **Capacity**
  - variables
  - definitions

- **Utilization**
  - teaching stations
  - schedules

- **Story Time**
  - stories & challenges
  - lessons learned
workshop agenda

- Perspectives
  - National
  - State
  - Local

- Addressing Constraints
  - Interpretations
  - Schedules
  - Multiple use
  - Joint use
  - Other Ideas

- Calculation Strategies
  - rules of thumb
  - specifics
Why Calculate School Capacity?

- to enroll the **right** number of students in a school facility

  or conversely

- to plan a school facility that is the **right** size for its intended enrollment

1. School construction funding
2. Maximize educational resources
3. Accommodate enrollments
4. Overcrowding & underutilization
5. Adjust Attendance Boundaries
6. others?
School Capacity Defined

- the number of students that can be reasonably accommodated by a school, building and site.

- physical variables
- operational variables
- programmatic variables
Capacity Variables

- **physical variables**
  - building size/area
  - number/types of teaching stations
  - support facilities (kitchen, lunchroom, etc)
  - infrastructure
  - net to gross ratio
  - building & life-safety codes
  - site amenities
Capacity Variables

- operational variables
  - utilization rates & efficiency
  - operational policies
  - staffing
  - funding structures
  - teacher/union regulations
  - space management
  - staff & operational budgets
  - specialty program offerings
Capacity Variables

- programmatic variables
  - class sizes & staff ratios
  - educational program offerings
  - operational models (teams, academies, etc.)
  - specialty programs
  - schedules
  - partnerships, off-site learning, etc.
  - extended use
Capacity: A Spectrum of Definitions

- **Maximum Capacity**
  The total number of student “seats” in the school facility.

- **Building Capacity**
  Also considers the extent of support facilities.

- **Functional Capacity**
  Also considers the desired level of schedule flexibility.

- **Program Capacity**
  Also considers curriculum and program offerings.

- **Temporary Capacity**
  Also considers temporary and make-shift facilities.
Maximum Capacity considers total student “seats”

for example:

25 students each used 8 of 8 periods = 100% utilization = 400 students/day

25(2) x 8(100%) = 400/day or 50 at any given period
Building Capacity considers:

- total student “seats”
- support facilities

such as:
- systems
- circulation
- toilets
- kitchen
- library
- offices
- etc.

Clark Middle School, Anchorage School District, McCool Carlson Green Architects
Functional Capacity

considers:

- total student “seats”
- support facilities
- schedule flexibility

For example:

25 students each
used 6 of 8 periods
= 75% utilization
= 300 students/day

25(2) x 8(75%) = 300
or 37-38 at any given time
**Program Capacity**

- **considers**
  - total student “seats”
  - support facilities
  - schedule flexibility
  - program offerings

25 students regular
15 students special
used 6 of 8 periods
= 75% utilization
= 240 students/day

\[25(1) \times 8(75\%) = 150\]

\[15(1) \times 8(75\%) = 90\]
Utilization

The educationally appropriate percentage of the school day that teaching stations can be used for instruction.

The ratio of unoccupied to occupied “seats” per teaching station per period.
Utilization

“seat” utilization

for example:

\[ \frac{24}{24} = 100\% \]

\[ \frac{24}{24} = 100\% \]
Utilization

“seat” utilization

For example:

18:24 = 75%

18:24 = 75%
# Utilization

## Rules of Thumb

<table>
<thead>
<tr>
<th>School Type</th>
<th>avg. utilization rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary</td>
<td>95-100%</td>
</tr>
<tr>
<td>Middle/Jr. High</td>
<td>70-85%</td>
</tr>
<tr>
<td>High</td>
<td>80-85%</td>
</tr>
</tbody>
</table>
## Utilization

**Example: Middle vs Junior High Schools**

<table>
<thead>
<tr>
<th></th>
<th>Middle School</th>
<th>Junior High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Stations</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Class Size</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Periods/day</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Teacher prep</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Team Planning</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Periods of Instruction</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Utilization Rate</td>
<td>71%</td>
<td>86%</td>
</tr>
<tr>
<td>Student Capacity</td>
<td>712</td>
<td>860</td>
</tr>
</tbody>
</table>

**difference = 148 students**
### Utilization

**Example: Middle vs Junior High Schools**

<table>
<thead>
<tr>
<th></th>
<th>Middle School</th>
<th>Junior High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Capacity</td>
<td>800</td>
<td>800</td>
</tr>
<tr>
<td>Class Size</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Periods/day</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Teacher prep</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Team Planning</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Periods of Instruction</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Utilization Rate</td>
<td>71%</td>
<td>86%</td>
</tr>
<tr>
<td>Teaching Stations</td>
<td>45</td>
<td>37</td>
</tr>
</tbody>
</table>

**difference = 8 teaching stations**
### Teaching Stations

**what counts?**

<table>
<thead>
<tr>
<th>School Type</th>
<th>what counts?</th>
<th>What about?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary</td>
<td>classrooms</td>
<td></td>
</tr>
<tr>
<td>Middle</td>
<td>classrooms</td>
<td>art &amp; music</td>
</tr>
<tr>
<td></td>
<td>science rooms</td>
<td>special education</td>
</tr>
<tr>
<td></td>
<td>gymnasium (x1)</td>
<td>computer labs</td>
</tr>
<tr>
<td>High</td>
<td>classrooms</td>
<td>special education</td>
</tr>
<tr>
<td></td>
<td>science rooms</td>
<td>media center</td>
</tr>
<tr>
<td></td>
<td>art &amp; music</td>
<td>auditorium/stage</td>
</tr>
<tr>
<td></td>
<td>gyms (x2)</td>
<td>computer labs</td>
</tr>
<tr>
<td></td>
<td>vocational programs</td>
<td>pe fields</td>
</tr>
<tr>
<td></td>
<td>etc…</td>
<td></td>
</tr>
</tbody>
</table>
### Teaching Stations

#### average class size

<table>
<thead>
<tr>
<th>School Type</th>
<th>average class size:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary</td>
<td>15-25 little variety</td>
</tr>
<tr>
<td>Middle</td>
<td>18-25 some variety</td>
</tr>
<tr>
<td>High</td>
<td>24-32 much variety</td>
</tr>
</tbody>
</table>
Case Study

comparison of facilities for science

Case “A”
2,780sf (2 rooms)
for 50 students
= 56 sf/student

Case “B”
2,260sf (2 rooms)
for 50 students
= 45 sf/student

size difference = 520sf or 11 sf/student
Case Study

Comparison of facilities for science

Case “A”
- say 25 students each
- used 6 of 8 periods
- = 75% utilization
- = 300 students/day

Case “B”
- say 25 students each
- used 6 of 8 periods
- = 75% utilization
- = 300 students/day

Main difference = area
Case Study

- comparison of facilities for science

Case “A”
- say 25 students each
- used 6 of 8 periods
- = 75% utilization
- or 37.5% “seat” utilization
- = 300 students/day

Case “B”
- say 25 students each
- used 6 of 8 periods
- = 75% utilization
- = 300 students/day

seat utilization difference = 37.5%
Case Study

comparison of facilities for science

Case “C”
say 65 students total
used 8 of 8 periods
= 100% utilization
= 520 students/day

Small Group

Prep Room

Faculty Office

(Greenhouse Option)

- Calculating School Capacity: CEFPI Pre-Conference Workshop - October 6, 2007
Case Study

Comparison of facilities for science

Case A:
- 200 Students
- 25 per Classroom
- 75% Utilization
- 10 Classrooms (13,900 sf total)
(excluding teacher offices & resource rooms)

Case B:
- 200 Students
- 25 per Classroom
- 75% Utilization
- 10 Classrooms (11,300 sf total)
(excluding teacher offices & resource rooms)

Case C:
- 200 Students
- 50 per Suite
- 100% Utilization
- 4 Suites (11,840 sf total)
(all inclusive)
Perspectives: National
for the median school district in the US

- Elementary Schools = 70 ft²/student
- Middle Schools = 70 ft²/student
- High Schools = 120 ft²/student

Source: School Planning & Management, February, 2006
Perspectives: National
for the median school district in the US

Elementary Schools = 90 ft²/student
Middle Schools = 111 ft²/student
High Schools = 153 ft²/student

Source: School Planning & Management, February, 2006
**Perspectives: National**

for the median school district in the US

<table>
<thead>
<tr>
<th>School Type</th>
<th>Area ( \text{ft}^2 )/Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary Schools</td>
<td>120</td>
</tr>
<tr>
<td>Middle Schools</td>
<td>146</td>
</tr>
<tr>
<td>High Schools</td>
<td>163</td>
</tr>
</tbody>
</table>

Source: School Planning & Management, February, 2006
Calculations

Gross Building Area - What Counts?

- lockers?
- dining/kitchen facilities?
- overhangs & canopies?
- vertical circulation?
- toilet facilities (specific to program)?
- exterior walls - to inside or outside face of wall?
## Perspectives: North America

### CEFPI’s National Averages (gross area per student)

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Elementary School Buildings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>104.2</td>
<td>74 - 133</td>
</tr>
<tr>
<td>Southern Tier of States</td>
<td>70.1</td>
<td>46 - 107</td>
</tr>
<tr>
<td>Remaining 48 states</td>
<td>111.5</td>
<td>77 - 147</td>
</tr>
<tr>
<td><strong>Middle School Buildings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>96.5</td>
<td>77 - 116</td>
</tr>
<tr>
<td>Southern Tier of States</td>
<td>81.2</td>
<td>77 - 90</td>
</tr>
<tr>
<td>Remaining 48 states</td>
<td>154.4</td>
<td>114 - 212</td>
</tr>
<tr>
<td><strong>High School Buildings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>130.4</td>
<td>91 - 166</td>
</tr>
<tr>
<td>Southern Tier of States</td>
<td>101.9</td>
<td>70 - 158</td>
</tr>
<tr>
<td>Remaining 48 states</td>
<td>160.7</td>
<td>123 - 211</td>
</tr>
</tbody>
</table>

Source: CEFPI Issue Track, November 1995
Perspectives: National

- Occupancy Loading
- Access & Egress
- Life-safety
- Support facilities
Perspectives: State Example

Alaska Department of Education & Early Childhood Development

Elementary Schools = 114 ft²/student
Middle Schools = 165 ft²/student
High Schools = 165 ft²/student

+ additional considerations for supplemental square-footage
Perspectives: State Example

Arkansas

Utilization Factors*:

K-5  = 100%
6-8   =  85%
9-12  =  85%

* for the purpose of planning

teaching station count = total student population (incl. SpEd) / average class size

Notes:
• Class sizes may vary from school to school.
• Self-contained classrooms are in addition to the calculated number of teaching stations.
• Art Music & PE do not count as teaching stations at the elementary level.

Source: Arkansas School Facility Manual, 2004
**Perspectives: State Example**

**Wyoming School Facilities Commission**

<table>
<thead>
<tr>
<th>No. of Students</th>
<th>19</th>
<th>57</th>
<th>114</th>
<th>228</th>
<th>342</th>
<th>&gt;450</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Elem. K-5</strong></td>
<td>155 SF</td>
<td>135 SF</td>
<td>185 SF</td>
<td>150 SF</td>
<td>140 SF</td>
<td>120 SF</td>
</tr>
<tr>
<td><strong>No. of Students</strong></td>
<td>&lt;150</td>
<td>150</td>
<td>350</td>
<td>550</td>
<td>&gt;650</td>
<td></td>
</tr>
<tr>
<td><strong>Middle 6-8</strong></td>
<td>TBD</td>
<td>300 SF</td>
<td>195 SF</td>
<td>160 SF</td>
<td>150 SF</td>
<td></td>
</tr>
<tr>
<td><strong>No. of Students</strong></td>
<td>&lt;150</td>
<td>150</td>
<td>350</td>
<td>550</td>
<td>&gt;750</td>
<td></td>
</tr>
<tr>
<td><strong>High 9-12</strong></td>
<td>TBD</td>
<td>360 SF</td>
<td>235 SF</td>
<td>195 SF</td>
<td>180 SF</td>
<td></td>
</tr>
<tr>
<td><strong>No. of Students</strong></td>
<td>&lt;85</td>
<td>85</td>
<td>171</td>
<td>342</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>K-8</strong></td>
<td>TBD</td>
<td>380 SF</td>
<td>300 SF</td>
<td>190 SF</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>No. of Students</strong></td>
<td>&lt;75</td>
<td>75</td>
<td>100</td>
<td>150</td>
<td>250</td>
<td>350</td>
</tr>
<tr>
<td><strong>K-12</strong></td>
<td>TBD</td>
<td>465 SF</td>
<td>430 SF</td>
<td>380 SF</td>
<td>280 SF</td>
<td>255 SF</td>
</tr>
<tr>
<td><strong>No. of Students</strong></td>
<td>&lt;75</td>
<td>75</td>
<td>100</td>
<td>150</td>
<td>250</td>
<td>350</td>
</tr>
<tr>
<td><strong>6-12</strong></td>
<td>TBD</td>
<td>525 SF</td>
<td>440 SF</td>
<td>350 SF</td>
<td>265 SF</td>
<td>255 SF</td>
</tr>
</tbody>
</table>

**Perspectives: State Example**

**West Virginia**

“The student capacity of a school building is affected by the educational program: it changes each time the program is modified.”

<table>
<thead>
<tr>
<th>Number of Teaching Stations</th>
<th>Number of students enrolled in subject</th>
<th>x</th>
<th>Number of periods per week in subject</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Desired average class size</td>
<td>x</td>
<td>Number of periods per week each teaching station can be used</td>
</tr>
</tbody>
</table>

*WV Board of Education, Handbook on Planning School Facilities, 2005*
Calculating the number and type of classrooms using the maximum program capacity for each regular or special classroom.

Assume that all students are seated in a first period block without pullout programs.

Do not include library/media, cafeteria, itinerant spaces, resource rooms, or optional academic classrooms such as art, music, and computer labs that act as pullout programs to support the core curriculum.
Perspectives: State Example

West Virginia

Secondary Schools:

Middle/Junior High School programs where various schedules exist, calculate the number and type of classrooms using the maximum program capacity for each regular or special classroom.

Assume for example that all students are seated in a first period block and with the exception of library/media, science labs, resource rooms or any space that cannot be used for other course offerings should be included in the daily capacity of each facility.

The maximum capacity for instructional spaces for specialty classrooms would be counted once and this type of space may be available throughout the school day but due to its specialized design or equipment render it impractical to use for other instructional purposes.

WVa Board of Education, Handbook on Planning School Facilities, 2005
Those schools that principals described as overcrowded used a variety of approaches to deal with the overcrowding:

- using portable classrooms (78%)
- converting non-classroom space into classrooms (53%)
- increasing class sizes (44%)
- building new buildings or additions (35%)
- using off-site instructional facilities (5%)
- or other approaches (12%).
**Perspectives: Local Example**

**Chicago Public Schools**

**Overcrowding**
Any school that exceeds 80% of its maximum capacity.

**Severe Overcrowding**
Schools that are above 100% of their maximum capacity.

**Underutilization**
If a school falls below 65% of its maximum capacity, it is assumed to have excess building space.

**Programmatic Exceptions**
For High Schools, CPS bases design capacity on curriculum programming. For instance, a Career Academy will be a larger building with larger classrooms where the programming of the school requires larger spaces for such needs as auto shops, or culinary arts kitchens. So you would have more space, but not necessarily more than an average number of students in the school.
Perspectives: Local Example

Chicago Public Schools

Elementary & Middle Schools
- 30 students - for average size classrooms (600-1200 sq.ft.)
- 15 students - for less than average size classrooms (less than 600 sq. ft.)
- 40 students - for above average size classrooms (more than 1200 sq. ft.)

High Schools
CPS uses figures mandated by the contract with the Chicago Teachers Union instead of the physical area of the classroom.

Exclusions
- spaces not originally intended as classrooms (i.e. auditoriums, gymnasiums, storage closets, etc.) that may currently be used as such
- temporary facilities such as mobile units, or "demountables" as they are now called.
For existing facilities, capacity is calculated by looking at the number of students divided by the total Building Square Footage.

**Elementary School**
- Capacity: $150 \text{ ft}^2/\text{student}$

**Middle/Junior High School**
- Capacity: $170 \text{ ft}^2/\text{student}$

**High School**
- Capacity: $180 \text{ ft}^2/\text{student}$

**Special Education**
- Capacity: $180 \text{ ft}^2/\text{student}$

Source: DCPS Facility Master Plan, 2001
Perspectives

Case Study: DC High Schools

Detailed findings from this floor space analyses led to the following recommendations:

1. revise the standard specs to allow greater flexibility so that existing high schools will not face a complete demolition of their interiors at extremely high cost;
2. change the floor space design standard value or eliminate its use altogether;
3. calculate the quantity of net floor space by measuring instructional and administrative space, thereby helping with the determination of enrollment capacities;
4. reexamine the quantity of total existing gross floor space, which is critical to the determination of excess space; and
5. undertake site studies to determine whether structured parking or other improvements are possible to alleviate site constraint problems.
Perspectives: Local Example

Clark County School District

Current prototype school ed specs include the following areas:

**Elementary**  =  96-100 ft²/student

**Middle/Junior High**  =  85-90 ft²/student

**High**  =  102-123 ft²/student

Source: Clark County School District – 2006 & 2007 K-12 Prototypes
Program capacity is calculated by considering various programmatic criteria including:

- Number of teaching stations available for instruction
- Average class sizes (regular & smaller)
- Utilization rates (& teacher preps)
- Extent of support facilities (considered but not calculated)

<table>
<thead>
<tr>
<th>Type</th>
<th>Class Sizes</th>
<th>Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary</td>
<td>24 &amp; 12</td>
<td>100%</td>
</tr>
<tr>
<td>Middle</td>
<td>28 &amp; 12</td>
<td>71% (5 of 7)</td>
</tr>
<tr>
<td>High</td>
<td>28 &amp; 12</td>
<td>83% (5 of 6)</td>
</tr>
</tbody>
</table>
Strategies for Increasing Capacity

- Scheduling (daily & annual)
- Multiple-Use Facilities
- Joint Use Facilities
- Off-Site Facilities
- Increase efficiency
- Reassignment of spaces
- others?
### Strategies for Increasing Capacity

#### Calendar & Schedule

<table>
<thead>
<tr>
<th>Month</th>
<th>Traditional Break</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sep</td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td></td>
</tr>
<tr>
<td>Jan</td>
<td></td>
</tr>
<tr>
<td>Feb</td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td></td>
</tr>
<tr>
<td>Jul</td>
<td></td>
</tr>
<tr>
<td>Aug</td>
<td></td>
</tr>
</tbody>
</table>

**TRADITIONAL**

- 600 students

**SINGLE-TRACK**

- 600 students

**MULTI-TRACK (example)**

- Track A – 200 students
- Track B – 200 students
- Track C – 200 students
- Track D – 200 students

**Assumptions for this example:**
- 1) school buildings can accommodate 600 students at one time
- 2) school facilities can support full-capacity increases
- 3) a 60/20 calendar is used
- 4) multi-track schedules include common winter and summer mini-breaks

---

Strategies for Increasing Capacity

Multiple-Use Facilities

South Anchorage High School: Perkins+Will and ECI Hyer

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Strategies for Increasing Capacity

Multiple-Use Facilities
Strategies for Increasing Capacity

- Faculty/Staff Support
Strategies for Increasing Capacity

Distributed Media Resources
Strategies for Increasing Capacity

Alternative Settings

[Images of alternative settings]

[Map of school layout]

Calculating School Capacity: CEFPI Pre-Conference Workshop - October 6, 2007
Strategies for Increasing Capacity

- Off-Site & Distance Learning
Strategies for Increasing Capacity

- Off-Site & Distance Learning

Henry Ford Museum Campus, Integrated School
Greenfield Village, Michigan, Concordia Consultants
Recommendations

For national, state & local guidelines

Country:
- Use Net Building Area

State:
- Consider State-wide specifics

District:
- Include District-wide parameters

School:
- Account for Specific Programs
Recommendations

For national, state & local guidelines

General

Country:

Use Net Building Area

- Calculate net usable vs gross building area for equity among facilities,
- Define what “counts” as net area vs what is gross area,
- Include Net:Gross area guidelines on a sliding scale that recognizes various climates, construction types, systems, etc.
- Consider the impact of national assessment mechanisms.
Recommendations

For national, state & local guidelines

- **Consider State-wide specifics**
  - Recognize climate and environment.
  - Incorporate funding mechanisms.
  - Define “baseline” net area parameters, then define and allow for exceptions as necessary.
  - Include Net:Gross area guidelines on a sliding scale that recognizes various climates, construction types, systems, etc.
  - Recognize state-wide student demographics & special needs.
  - Consider the impact of state-wide assessment mechanisms.
Recommendations

For national, state & local guidelines

- Include District-wide parameters
  - Accommodate district-wide educational initiatives.
  - Understand student demographics and special needs.
  - Reflect operational budgets and strategies.
  - Consider attendance boundaries and transportation.
  - Recognize various scheduling options.
  - Address teacher needs and contracts.
Recommendations

For national, state & local guidelines

- Account for Specific Programs
  - Address curriculum, program offerings and specific class sizes.
  - Incorporate intended scheduling flexibility (utilization factor)
  - Reflect the intended scheduling strategy (block, YRE, etc.)
  - Consider operational and organizational specifics.
  - Accommodate various individual needs of the school community.
  - Allow for gross area variation based on specific climate/environment.
Calculating School Capacity:

thank you!

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