
The Pool & Spa Show
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MAHC/CMAHC and Other Acronyms

- Who knows about the Model Aquatic Health Code (MAHC)?
- Who knows about the Council for the MAHC (CMAHC)?
- Who is a member of the CMAHC?
MAHC and Aquatics Industry Partnership

Keeping Pools Safe

and

Keeping Pools Open

are shared motivators for the MAHC and aquatics industry
Why Create the MAHC?

- No federal regulatory agency responsible for aquatic facilities
- 68% of state and local health departments regulate, inspect, or license public swimming pools¹
- Significant variability in standards and requirements exist that are often outdated
- Significant time and resources spent by individual jurisdictions to create and update codes

¹ National Association of County and City Health Officials, 2013.
Code Development Process with the MAHC

- MAHC was developed by expert consortia of national and international stakeholders

- Substantial industry participation in the process
  - Results in better acceptance by industry
  - 72% of >4400 public comments accepted

- Annex is a valuable tool that provides the data and other supporting evidence for the code requirements

- Updated every two years through the Council for the Model Aquatic Health Code (CMAHC)
MAHC is Intended to Make Pools Safer: Risk Management Approach

- Understanding & identifying risk
  - Drowning
  - Disease
  - Injury

- Developing methods to manage the risk
  - Physical methods (DESIGN)
  - Operational methods (TRAINING)
  - Management methods (PLANNING & AUDITING)

- Assessing compliance
The Conference for the Model Aquatic Health Code (CMAHC)

- **What is CMAHC?**
  - 501c(3) non-profit organization

- **Why does it exist?**
  - Established in 2013 to manage updates to the MAHC

- **Administration & Operation**
  - Bylaws, Board of Directors, Executive Director
  - Committees include Technical Review Committee and Ad Hoc Committees
The Conference for the Model Aquatic Health Code (CMAHC)

- **Role**
  - Conduit for funneling advice and data-driven, science-based information from public health and aquatic industry experts to CDC
  - Support use of MAHC

- **Vision**
  - To keep the MAHC up-to-date, science-based, sustainable, easily understood and implemented by pool programs across the U.S. so as to support healthy and safe aquatic experiences for everyone.
The Conference for the Model Aquatic Health Code (CMAHC)

- **Mission**
  - Collect, assess, and relay input on MAHC revisions back to CDC for final acceptance
  - Provide advocacy and needed support to health departments and other partners on using the MAHC
  - Solicit, coordinate, and prioritize research needs
The MAHC 1st Edition Code & Annex

The Code – 316 pgs, 243 model code language

The Annex – 371 pgs, scientific rationale, explanatory text, references for code
What’s Inside?

1) Preface
2) User Guide
3) Glossary, Acronyms, Initialisms
4) Design and Construction
5) Operation and Maintenance
6) Policies and Management
7) MAHC Resources
8) Appendices

4.1 Plan Submittal

4.1.1 Purpose

AQUATIC FACILITY construction plans shall be designed to provide sufficient clarity to indicate the location, nature, and extent of the work proposed.

4.1.2 Conform

AQUATIC FACILITY construction plans shall show in detail that it will conform to the provisions of this CODE and relevant laws, ordinances, rules, and regulations, as determined by the AHJ and to protect the health and safety of the facility’s patrons.

4.1.3 Approved Plans

No person shall begin to construct a new AQUATIC FACILITY or shall SUBSTANTIALLY ALTER an existing AQUATIC FACILITY without first having the construction plans detailing the construction or SUBSTANTIALLY ALTERATION submitted to and approved by the AHJ.

4.1.4 Plan Preparation

All plans shall be prepared by a design professional who is registered or licensed to practice their respective design profession as defined by the state or local laws governing professional practice within the jurisdiction in which the project is to be constructed.

4.1.5 Required Statements

All construction plans shall include the following statements:

1) “The proposed AQUATIC FACILITY and all equipment shall be constructed and installed in conformity with the approved plans and specifications or approved amendments,” and

2) “No SUBSTANTIALLY ALTERATION, changes, additions, or equipment not specified in the approved plans or allowed in the CODE can be made or added until the plans for such SUBSTANTIALLY ALTERATION, changes, additions, or equipment are submitted to and approved by the AHJ.”
4.0 FACILITY DESIGN STANDARDS AND CONSTRUCTION

The provisions of MAHC Chapter 4 (Facility Design Standards and Construction) apply to construction of a new aquatic facility or aquatic venue or substantial alteration to an existing aquatic facility or aquatic venue, unless otherwise noted.
Facility Design & Construction Agenda

- Plan submittal
- Consultation
- Indoor/Outdoor Environment
- Pool Shell/Structure
- Water Treatment
- Hygiene Facilities
AQUATIC FACILITY PLAN PROCESS: SUBMITTAL
Plan Submittal

4.1.1.2 Conform
Aquatic facility construction plans shall show in detail that it will conform to the provisions of this code and relevant laws, ordinances, rules, and regulations, as determined by the AHJ and to protect the health and safety of the facility’s bathers and patrons.
Plan Submittal

4.1.1.3 Approved Plans

No person shall begin to construct a new aquatic facility or shall substantially alter an existing aquatic facility without first having the construction plans detailing the construction or substantial alteration submitted to and approved by the AHJ.
Plan Submittal

4.1.1.4 Plan Preparation
All plans shall be prepared by a design professional who is registered or licensed to practice their respective design profession as defined by the state or local laws governing professional practice within the jurisdiction in which the project is to be constructed.
AQUATIC FACILITY PLAN PROCESS: CONSULTATION
4.1.2.2.1.1 Operating Conditions
The design documents shall include record of operating conditions (water temperature(s), space temperature, space relative humidity, space dew point) and intended use for each type of venue (flat water, agitated water, hot water) accepted by both the design engineer and owner/operator.
4.1.2.3.2.1 Intended Use

Design of the ventilation and air handling systems for indoor aquatic facilities shall include consultation with, and input by, the owner/operator to address intended use, type of venue (flat water, agitated water, hot water) and intended typical operating water temperature.
Consultation

4.1.2.3.11 Design for Risk Management

The layout for zones of patron surveillance as specified in Section 6.3.3.1.1 Zone of Patron Surveillance shall be included and must show features or design configurations that can impact patron surveillance.
Consultation

4.5.1 Design for Risk Management
Design of aquatic facilities and/or aquatic venue(s) shall include consultation with and input by the owner and/or an aquatic risk management consultant and address operational considerations such as the layout of zones of patron surveillance.
Examples of Features or Design Configurations that Can Impact Patron Surveillance

Facility design and features....
Examples of Features or Design Configurations that Can Impact Patron Surveillance

Curves, islands, vegetation....
Examples of Features or Design Configurations that Can Impact Patron Surveillance

Spray features....
AQUATIC FACILITY/VENUE ENVIRONMENT:
INDOOR AQUATIC FACILITY VENTILATION
MAHC Ventilation Requirements

Background

- Purpose - health and safety of building’s patrons
- Most codes only address moisture control
- Variety of health effects can occur due to poor ventilation due to accumulation of chemical and biological products in the air
Indoor Aquatic Facility Air Quality

- Findings/conclusions of MAHC Ventilation & Air Quality Technical Committee
  - Poor indoor air quality has increasingly been linked to health effects
  - Increased reporting of health events
  - Large indoor facilities have proliferated
  - Bather exposure times longer in these facilities
  - Does not appear that ventilation standards are adequate to keep up with aquatics needs
MAHC Ventilation Requirements

- MAHC Ventilation & Air Quality requirements
  - Require compliance with ASHRAE 62.1
- Include as a priority research item
  - Develop guidance to improve indoor air quality at aquatic facilities
  - Determine if the problem is inadequate design, poor operation, poor maintenance, or a mix
MAHC Ventilation Requirements

- MAHC Ventilation & Air Quality requirements
  - Require compliance with ASHRAE 62.1

- Performance Requirements
  - Minimum amount of outdoor air
  - Minimum air delivery rate
  - Air flow/distribution
  - Relative humidity & dew point
  - Disinfection by-product removal
  - Intake locations (avoid re-entrainment of exhaust)
  - Purge
AQUATIC FACILITY/VENUE ENVIRONMENT: GLARE
4.6.1.8 Glare

Windows and any other features providing natural light into the pool space and overhead or equivalent deck lighting shall be designed or arranged to inhibit or reduce glare on the pool water surface that would prevent seeing objects on the pool bottom.
Example for the Impact of Glare

The sun can be a big issue both outside and inside....
Glare Design Considerations

- Windows and skylights
  - Position overhead - less likely to cause glare than if positioned lower on walls at sides and ends of pool

- Artificial light placement
  - Angle of incidence less than 50 degrees from directly overhead
  - Diffuse or indirect light sources
AQUATIC FACILITY/VENUE ENVIRONMENT: DECKS-SLIP RESISTANCE
4.8.1.4.2 Slip Resistance

All decks shall have slip-resistant, textured finishes, which are not conducive to slipping under contact of bare feet in wet or dry conditions. All surfaces required to be slip-resistant shall have a minimum dynamic coefficient of friction at least equal to the requirements of ANSI A137.1-2012 for that installation as measured by the DCOF AcuTest.
Industry Standard Changed
- More accurate method for determining slip resistance adopted by Tile Council of North America
- Previous test method (ASTM C1028) replaced with new method –DCOF AcuTest- to test dynamic coefficient of friction, or DCOF.
POOL SHELL/STRUCTURE:
BOTTOM SLOPE
4.5.2.2 Under Five Feet

In water depths under five feet (1.5 m), the slope of the floor of all pools shall not exceed one foot (30.5 cm) vertical drop for every 12 feet (3.7 m) horizontal.
Bottom Slope Design Considerations

- Non-swimmers
  - Buoyancy-water depth less than chest deep
  - Steeper slope-too deep too fast

4.5.19.5.3 Safety Rope
- One foot (30.5 cm) to the shallow water side of the break in floor slope and contrasting band, a safety float rope shall extend across the pool surface with the exception of wave pools, surf pools, and waterslide landing pools.
POOL SHELL/STRUCTURE:
COLOR AND FINISH-MUNSELL COLOR VALUE
Color and Finish

4.5.11.1.1 Munsell Color Value
The finish shall be at least 6.5 on the Munsell color value scale.
Many Pool Codes Specify Pool Walls & Floors to be “white or light colored.”
- Somewhat subjective

Munsell Color Order System
- Addresses chroma (color purity), hue (red, yellow, green, blue, purple), and value (lightness)
  - **Value scale** ranges from 0 (pure black) to 10 (pure white)
- System used in other industries
- Information is easily available
Color and Finish

4.5.11.1.1 Munsell Color Value
The finish shall be at least 6.5 on the Munsell color value scale.
POOL WATER TREATMENT:
SECONDARY DISINFECTION
Secondary Disinfection

4.7.3.3.1.2 Required Facilities

The new construction or substantial alteration of the following increased risk aquatic venues shall be required to use a secondary disinfection system after adoption of this code:

1. Aquatic venues designed primarily for children under 5 years old, such as
   a) Wading pools,
   b) Interactive water play venues with no standing water, and

2. Therapy pools.
4.7.1.2.2 Secondary Disinfection

If secondary disinfection is required for an increased risk aquatic venue as per MAHC Section 4.7.3.3.1.2, then secondary disinfection shall be required for all treatment systems that are combined with the increased risk aquatic venue.
Secondary Disinfection

- Key Design Elements
  - 3-log inactivation
    - Third party validation required
      - UV equipment shall be third party validated in accordance with the practices outlined in the US EPA Ultraviolet Disinfectant Guidance Manual dated November, 2006, publication number EPA 815-R-06-007.
      - Ozone systems shall be validated by an ANSI-accredited third party testing and certification organization to confirm that they provide a minimum 3 log (99.9%) inactivation of Cryptosporidium.
Secondary Disinfection

- **Key Design Elements (continued)**
  - **Minimum Flow Rate Calculation**
    
    Accounting for a 3 log (99.9%) reduction of infective *Cryptosporidium* oocysts through the secondary disinfection system with each pass, the secondary disinfection system flow rate \( Q \) shall be:
    
    \[
    Q = V \times \left\{ \frac{14.8 - \ln (V)}{60 \times T} \right\}, \text{ where:}
    \]
    
    - \( Q \) = Secondary disinfection system flow rate (gpm)
    - \( V \) = Total water volume of the aquatic venue or aquatic feature, including surge tanks, piping, equipment, etc. (gals)
    - \( T \) = Dilution time (hrs.)
Secondary Disinfection

- Key Design Elements (continued)
  - “T” (Time for Dilution)
    - Lesser of 9 hrs, or
    - 75% of uninterrupted time the venue is closed in a 24 hr period
Secondary Disinfection Example

An example of how to calculate for the needed flow is as follows:

- \( Q = V \times \left\{ \frac{[14.8 - \ln (V)]}{(60 \times T)} \right\} \), where:
  - \( Q \) = Secondary disinfection system flow rate (gpm)
  - \( V \) = Total water volume of the aquatic venue or aquatic feature, including surge tanks, piping, equipment, etc. (gals)
  - \( T \) = Dilution time (hrs.)

For a 100,000 gallon (378,541 L) aquatic venue which is closed 12 continuous hours out of every 24 hours, 75% of which is 9 hours:

- \( 100,000 \times \left\{ \frac{[14.8 - \ln (100,000)]}{(60 \times 9)} \right\} = 609 \text{ gpm} \)
  - (note: natural log (ln) of 100,000=11.51)
POOL WATER TREATMENT: COMBINED VENUE TREATMENT
4.7.1.2 Combined Aquatic Venue Treatment

4.7.1.2.1 Maintain and Measure
When treatment systems of multiple aquatic venues are combined, the design shall include all appurtenances to maintain and measure the required water characteristics including but not limited to flow rate, pH, and disinfectant concentration in each aquatic venue or aquatic feature.

5.7.1.2 Combined Venue Treatment
Each individual aquatic venue in a combined treatment system shall meet required turnover times specified in MAHC Section 5.7.1.9 and achieve all water quality criteria (including, but not limited to, pH, disinfectant concentration, and water clarity/turbidity).
Combined Venue Treatment

4.7.1.2 Combined Aquatic Venue Treatment
   4.7.1.2.1 Maintain and Measure

   4.7.1.2.2 Secondary Disinfection
   4.7.1.2.3 Isolate

   When multiple aquatic venues are combined in one treatment system, each aquatic venue shall be capable of being isolated for maintenance purposes.
POOL WATER TREATMENT:
FLOW TURNDOWN SYSTEM
Flow Turndown System

4.7.1.10.6 Flow Turndown System

For aquatic facilities that intend to reduce the recirculation flow rate below the minimum required design values when the pool is unoccupied, the flow turndown system shall be designed as follows in MAHC Section 4.7.1.10.6.1 through MAHC Section 4.7.1.10.6.2.
Flow Turndown System

- **Key Design Elements**
  - Flowrate – turndown not more than 25%
    - Use of variable frequency drive (vfd) pumps
    - Only when venue is unoccupied
      - Clarity must be maintained.
      - Disinfectant and pH levels maintained.
Flow Turndown System

- Key Design Elements (continued)
  - Increase – when used to increase above min. requirement (e.g., in times of peak use to maintain water quality goals more effectively)
    - Velocity requirements inside pipes must be met
    - Max. filtration systems flows not exceeded
AQUATIC FACILITY/VENUE: HYGIENE FACILITIES

MAHC Hygiene Facility Requirements

Background

- **Recreational water-associated diarrheal illness from pool contamination by bathers**
  - Few people shower before swimming
  - Fecal incidents at pools are common
    - 5% of public had diarrhea in past month
    - ~0.14 g of feces on peri-anal surface/person
    - 20% of adults don’t know that you shouldn’t swim when ill with diarrhea

- **Secondary disinfection systems are circulation dependent**
MAHC Hygiene Facility Requirements
Background (continued)

- Changing bather behavior needed to help prevent outbreaks
  - Hygiene facilities can help
- Hygiene facilities must be:
  - Properly designed
  - Conveniently located
  - Well maintained
Hygiene Facilities

4.10.1.2 Minimum to Provide

Aquatic facilities shall provide hygiene facilities that include, at a minimum, toilets, urinals, showers, diaper-changing stations, and other hygiene fixtures, as specified herein.
Hygiene Facilities

- Key Design Elements
  - Minimum number of fixtures required:
    - applicable state/local codes, or
    - based on Theoretical Peak Occupancy
Theoretical Peak Occupancy

4.1.2.3.5.3 Calculating Theoretical Peak Occupancy

The theoretical peak occupancy shall be calculated by dividing the surface area in square feet of the aquatic venue by the density factor (D) that fits the specific aquatic venue being considered.

\[
\text{theoretical peak occupancy} = \frac{\text{aquatic venue surface area}}{D}
\]
Theoretical Peak Occupancy

The density factors (D) are:

Water/bather-related:
1. Flat water density factor = 20 ft\(^2\) (1.9 m\(^2\)) per bather.
2. Agitated water density factor = 15 ft\(^2\) (1.4 m\(^2\)) per bather.
3. Hot water density factor = 10 ft\(^2\) (0.9 m\(^2\)) per bather.
4. Waterslide landing pool density factor = manufacturer-established capacity at any given time.
5. Interactive water play water density factor = 10 ft\(^2\) (0.9 m\(^2\)) per bather on surface.
6. surf pool density factor = manufacturer-established capacity at any given time.

Non-water/Patron-related:
7. Deck density factor = 50 ft\(^2\) (4.6 m\(^2\)) per bather.
8. Stadium seating density factor = 6.6 ft\(^2\) (0.6 m\(^2\)) per Bather.
Hygiene Facilities

- **Key Design Elements**
  - Minimum number of fixtures required:
    - applicable state/local codes, or
    - based on Theoretical Peak Occupancy
  - **Location**
    - No greater than 300 ft. walking distance from each Aquatic Venue
    - No greater than 200 ft. for venues designed primarily for children less than 5 yrs. of age
Hygiene Facilities
Diaper-Changing Stations (4.10.4.5)

- **Key Design Elements**
  - At all facilities upon adoption (retroactive)
    - 1 in each male & female hygiene facility or provide a unisex station
  - Conform to either:
    - ASTM standard F2285-04: Consumer Performance Standards for Commercial Diaper-Changing Stations, or
    - The standards for diaper-changing surfaces in the most current version of Caring for Our Children: National Health and Safety Performance Standards: Guidelines for Out-of-Home Child Care
Hygiene Facilities
Showers
(Cleansing & Rinse)

- **Cleansing Showers** (4.10.4.2)
  - The minimum number of cleansing showers shall be one per sex for aquatic facilities less than 4000 square feet (372 m²) in collective aquatic venue surface area.
    - An additional cleansing shower per sex shall be added for each additional 4000 square feet (372 m²) of aquatic venue space or portion thereof.
Hygiene Facilities
Showers
(Cleansing & Rinse)

- **Rinse Showers** (4.10.4.3)
  - A minimum of one rinse shower shall be provided on the deck near an entry point to the aquatic venue.
  - Water used for rinse showers may be at ambient temperature.
Hygiene Facilities
Showers
(Cleansing & Rinse)

- **Rinse Showers** (4.10.4.3)
  - Rinse showers in aquatic facilities greater than 7500 square feet (697 m²) of water surface area shall be situated adjacent to each aquatic venue entry point or arranged to encourage bathers to use the rinse shower prior to entering the aquatic venue.
  - A minimum of four showerheads per 50 feet (15.2 m) of beach entry aquatic venues shall be provided as a rinse shower.
Hygiene Facilities
Showers
(Cleansing & Rinse)

- **Rinse Showers** (4.10.4.3)
  - A minimum of one rinse shower shall be provided at each entrance to a lazy river aquatic venue.
  - A minimum of one rinse shower shall be provided at each entrance to a waterslide queue line.
Hygiene Facilities
Showers
(Cleansing & Rinse)

- **All Showers (4.10.4.4)**
  - Aquatic facilities with 7500 square feet (697 m²) of water area or more may be flexible in the number of cleansing showers they provide based on the theoretical peak occupancy in MAHC Section 4.1.2.3.5:
    - 25% of the required showers shall be cleansing showers,
    - 25% of the required showers shall be rinse showers, and
    - the remaining 50% may be either cleansing or rinse showers.
Website Information

Website: www.cdc.gov/mahc
Email: mahc@cdc.gov

Website: www.cmahc.org
Email: info@cmahc.org
MEMBERSHIP:
HOW TO BECOME A CMAHC MEMBER
Get Involved. Become a Member

The MAHC, unlike other codes, is kept sustainable, current and complete because the people who use it vote on its content every other year. Through membership in the CMAHC.

The MAHC is written by the best experts in our industry - CMAHC members! Members have the ability to submit proposed changes to the MAHC to be evaluated by a Technical Review Committee. And only CMAHC members can provide comments and vote on proposed changes to the MAHC. This is your year to Vote on the Code; there are over 157 changes proposed. We need your vote, and your attendance at the Vote on the Code Biennial Conference.

CMAHC membership is only $40 for two years - the membership is kept low, based on feedback during the 2014 CMAHC Organizational Meeting. We want to encourage broad and extensive membership by everyone involved with aquatics. It is your expertise that drives the CMAHC.

The CMAHC is unique in that it exists solely to promote and sustain the MAHC for adoption. We are also your direct conduit to the CDC.

Join us as a Member today and your membership will be valid through the CMAHC Vote on the Code 2017 Biennial Conference. After that point, all memberships will cover a single biennial conference cycle from initial change request submissions to final voting.

Sign up using our secure form.
Cautionary Note

- How does the CMAHC ensure there is a visionary group(s) looking at where U.S. aquatics should be 10, 20, 30 years from now?
  - Must overcome the tendency to only react or continually tweak the MAHC without a long range goal to improve overall system
    - Excellence vs. perfection
    - Data arguments to promote vs. stop progress
    - Should be planning where entire system should be moving and incrementally submit CRs and research data to get us there (e.g., filtration-recirc, air handling, advance water treatment)

- Need a proactive strategy so we advance MAHC vs. just finesse wording
  - Will never have true advances if we don’t