







Technology National Engineering Center for Building Laboratory

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asonry, concrete,

one, water

. Interior

Mass

EXAMPLES . WS 72

A. Air Tightness

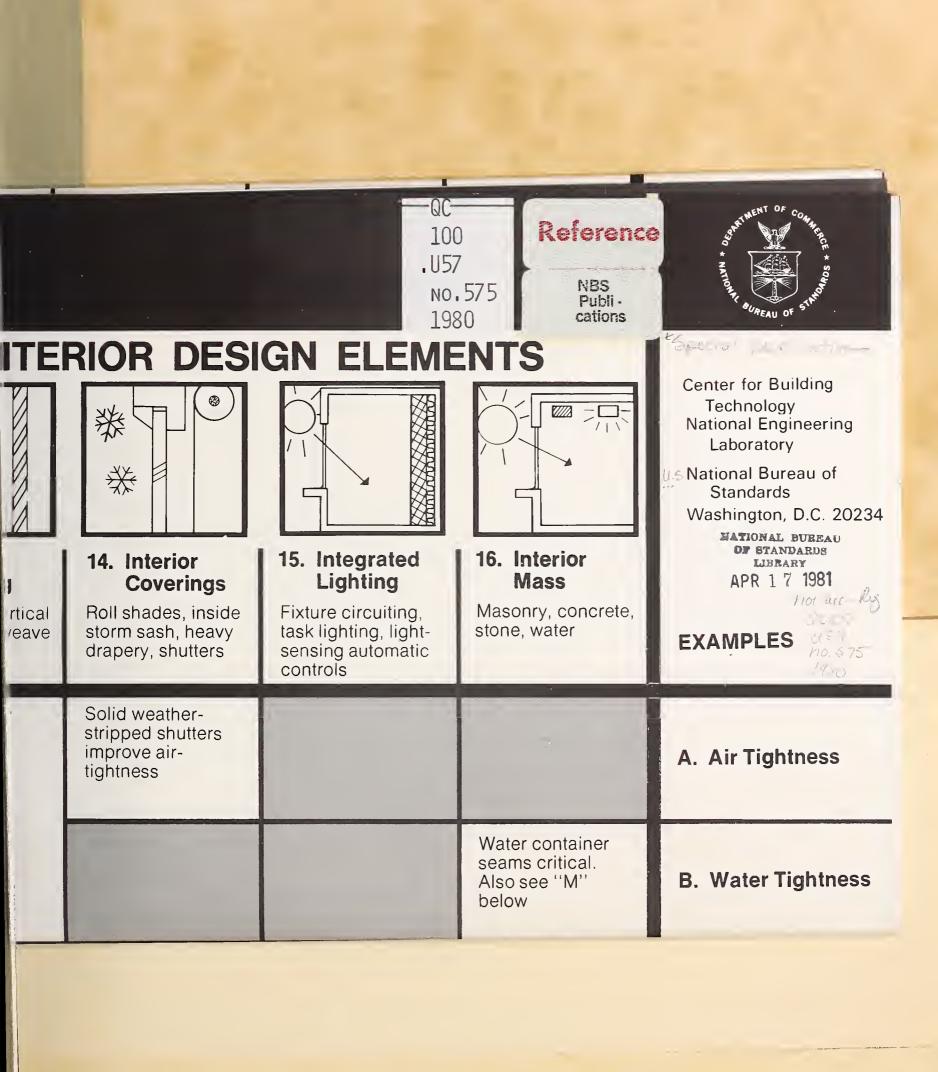
iter container

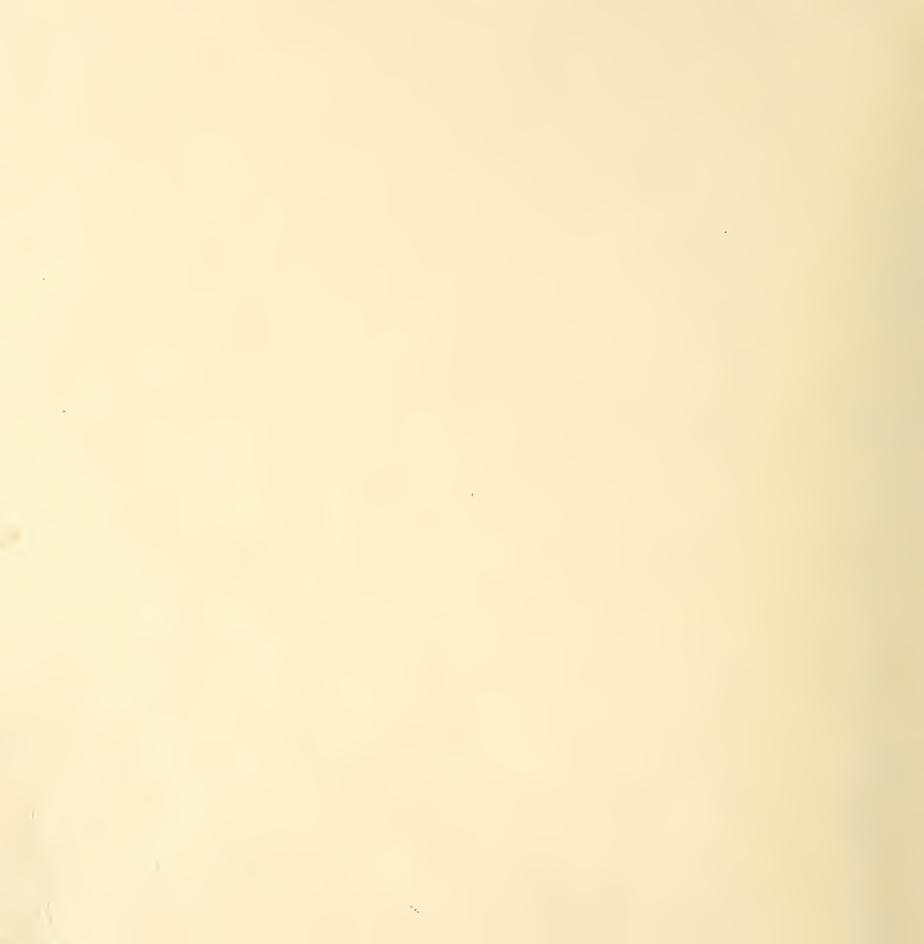
tms critical. ∧<sub>O</sub>

B. Water Tightness

QC-100 .U57 No.575 1980









## DESIGN FOR BETTER WINDOW PERFORMANCE

100 . U57 No.575 1980

Reference

NATIONAL BUREAU OF

EXA

1. Landscaping | 2. Shades



3. Coverings

Interior operation of exterior devices de-sirable to meet changing exterior condi-tions or interior requirements

May deter intruders depending on ease of removal or noise from breakage. Locked shutters or rott blinds very elfective

Must withstand wind, rain, ice, and intense

Musicand wind, rain, ice, and intense solar radiation. May require seasonal removal Some are sell storing—e.g., rotler awnings. Detail installation to avoid staining adjacent materials

ganic debris ay reduce ease

lay provide cove

K. Ease Of Operation

.. Forced Entry

M. Durability/ Maintenance

| 4. Sun

5. Insulated Frames

Must resist forces

prevent binding of sash

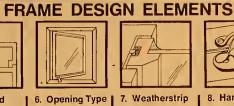
Rigidity of frame and sash importa

Thermal break material must be

UV stable or protected from sunlight

appearance is diminished by fading













Decreased weight makes operation

lo 1000" C = 1000"

Easily scratched. May increase

Va" glass breaks when ¼ lb. steel badropped on a 12" sq. Sample at height of

Stand blk. = 200" Solid = marred at 320"

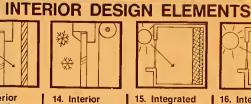
Very durable but it damaged, replacement difficult



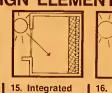




Shading



Coverings



Lighting



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mest Ambler, Director		Sun screens, louvers, awnings, architectural projections	Roll blinds, shutters, storm sash	South-facing windows	Wood or metal with a thermal break	Casement, awning, double-hung, sliding, jalousie, pivoting and hopper	Pile, vinyl, foam, brass, or copper	devices, locks, and hinges	organically sealed insulating glass	Reflective coated glass or films	Polycarbonate (PC) or acrylic (AC) sheet	Hollow masonry units of glass	Venetian or vertical blinds, open-weave drapery	Roll shades, inside storm sash, heavy drapery, shutters	Fixture circuiting, task lighting, light-sensing automatic controls	Masonry, concrete, stone, water	EXAMPLES
. Air Tightness	Reduced potential for water or air leakage to the extent that windbreak shields the window. Provide positive drainage for trapped water Lack of drainage and freezing can increase air and water leakage		May or may not coincide with optimum orientation for summer prevailing breezes vs. winter	Are as important as insulating value. Per formance varies greatly with quality of wildow and type of operation. Hinged wildows tend to be more airlight than vert. horiz. sliding units. Excellent to minimul performance: 0.1 to 0.5 cfm per crack to		degrades with use, ease of replacement essential. Pile type w/fin desirable for	By cam action hardware can force tight closure of sash. Improper design can twist frame causing			Large thermal movement requires large edge clearance, deep containment, gaskets or flexible	Seal at joint between adjacent construction and glass block important. Expansion can be great.	Negligible	Solid weather- stripped shutters improve air- lightness			A. Air Tightness	
3. Water Tightness	water velocity			wind. Correct conflicting orientation requirements by using other design elements such as	Specify mfgr's product	M e283-73 test. Note: clion average. Provide dd keep weeps clear. alousie provide some nopen. ASTM E-331 st used for evaluation	sliding units; use compression or spring type for hinged units	increased air and water infiltration	Drain sill channels well to prevent failure of organic edge seal of glass		sealants	great				Water container seams critical Also see "M" below	B. Water Tightness
C. Natural Ventilation	A windbreak may alter summer wind direction and increase or decrease local velocity  May impede natural ventilation. Even insect screen reduces air flow by 50% of the screen reduces ai		wind secept or planting		Direction and axis of opening directs air flow. Openable free area critical		May limit how window opens thus affecting quantity and quality of ventilation				Operable vents available same size as block module	Concurrent shading and ventilation desirable	Closed mode may preclude natural ventifation		Mass cooled by night air can provide daytime cooling	C. Natural Ventilation	
D. Insulation	erosion of insulating I	des will reduce rate of layer of air at surface ndow is shielded from	between covering	Sol-air temperature useful concept. See ASHRAE Handbook of Fundamentals. Locate spaces to	Should be specified with multiple glazing in moderate and severe climates				Storm = 0.5 Double = 0.6 (½" space)	Single glass U-value: (v I.R. refl. = 0.7 Sol. refl. ≠ 0.9	winter) = 1.10 btu/ft²h°f  Polycarbonate or acrylic = 1.06	12" sq. face 1 cavity = 0.52 2 cavity = 0.44	Minimal if free movement of room air between device and window	Depends on air- tightness of covering and tightness of edge fit		Daylime heat loss reduced because mass absorbs heal, reducing over- healing of space	D. Insulation
E. Solar Admittance	Trees and tall hedges can reduce insulation	edges can reduce between window gain according to		receive winter sun during time of occupancy		ns of sash and frame mem- olar gain. Use net glazing lations			1/8 "glas ( $1/8 + 1/8$ ) clear: sc = 0.89 % sol = 69	Low example sc = 0.38 % sol = 17	sc = 0.38 = 0.98  PC  sc = 0.65		Shading coeff Ven. Blind ⊨ 0.6* Open weave' curtains ⊨ 0.8* *Closed	ff V <sub>8</sub> " gl = 1.0  Roll shade = 0.3* Tight weave curtains = 0.3* *Closed		Solar heat absorbed by mass permits greater glass area, w/o overheating	E. Solar Admittance
F. Daylighting	Landscaping elements may block daylight if in overgrown condition land to the condition		Intensive solar exposure for winter heating may cause glare. Provide control using design elements	to reduce contrast gl	s should be a light color glare. Position window or maximum room depth ion			% vis = 81	%" glass: % visible  Low example % vis = 15	e transmission (vis) = 90 % vis = 92 AC = 88 PC	High example % vis = 75	Experimental reflective Venetian blind Contact: 1 Oak Ridge Lab 2 Lawrence Berkeley Lab	Can be effective for complete black-out	Daylight sensing control operation on/off or continuous dimming	Dark color for solar absorption reduces room daylighting	F. Daylighting	
G. Visual Separation	Opportunity to provide privacy as desired  Some types as seen from outside are opaque during day but transparent at night		1						Tend to distort color rendition of view and correct sense of time	Scratches can detract from quality of view out	View out/in distorted or entirely obscured depending on type	See exterior shading	and coverings		"Mass" walls can provide complete visual separation and passive solar heal	G. Visual Separation	
H. Acoustical Isolation	Principal benefit is psychological. Provides minimal actual sound isolation Decreases as distance of noise increases. Overhangs can reflect noise to the window Can be effective if airlight and materials not same thickness or density			· 		Airtightness critical to "sound tightness"			$$V_6''$ single glass sound transmission loss (db) = 24$$$V_2''$ cavity = 32$$$6''$ cavity = 40$$$120$$$45$$$120$$120$$$120$$$120$$$120$$$			Negligible	Depends on air- lightness as in "D" above	No lighting syslem hum with daylight	Mass provides the best acoustical isolation if no penetrations	H. Acoustical Isolation	
I. Safety	Could aller circu- lation patterns to keep people away from windows	Projections within 7 ft. of grade may be hazardous to pedestrians	Can reduce tre- quency or severity of breakage- related accidents			Windows projecting in or out can be hazardous depending on location	Should not require excessive force to open or close window	Can limit opening dimensions to prevent children from falling out	Insulating glass eliminates hazard of installing/ removing storm sash	May cause disorienting glare to pedestrians/ drivers	Reduced probability accidents	of breakage-related	May help prevent dire in impact situations	ect contact with glass		Check allowable floor loading, caution in disposal of toxic additives	i. Safety
J. Access/ Egress	Must be located so as not to block emergency access or egress	emergency exiting the	movable from inside for through windows used of reduce area or dimen- m required		Must not interfere with easy exiting	Typical exit window: 5.7 sq. ft. min. area, 21" min. dimension, 44" max. sill height	Should not inhibit the easy opening of windows used for emergency egress	Should facilitate rapid opening for emergency egress	Greater hazard to enter/exit through broken-out window	Avoid creating reflections that could confuse emergency exiting	Pop out gaskeling may be desirable for egress through fixed units	Essentially inpenetrable for emergency egress	Should not hide wind duce the likelihood o gency egress, nor opening qualities	their use for emer-			J. Access/ Egress

Must be detailed to permit periodic replacement

See "I" above

Solt weather-

wire to unlock window

emovable hinges. Sash or glass should be emovable trom

parls the greater he possible need

Gear reduction or

Function, quality

placement, and anchorage critical to security

Simple is beautifu and makes

operation

Requires no

management by the occupant

mpedes outside

Scratch resistance important Caution in cleaning

surveillance

creased weigh

makes operation nore difficult due

ee "J" above

Can discourage

Due to easy accessibility interior covering are more likely to be used

he need for periodic cleaning makes ease fremoval desirable

K. Ease Of

L. Forced Entry

M. Durability/

Resistance

No operation

operation required

Can be integrated

with security system to lurn on lights upon intrusion

