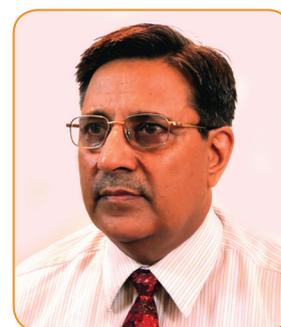


# GUIDELINES ON USE OF GLASS IN BUILDINGS— Ensures Human Safety



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## Safety Main Concern

With the increased activities and growth in the building and housing sector in India, glass has emerged as one of the popular and inevitable building material due to its inherited merits and its use has been increased many folds especially in shopping malls, commercial complexes, offices, hotels, hospitals, airports etc and now even in residential buildings which would obviously be causing fear for risk of human injury. As per an estimate glass sale of 886 MT/day in 2000-01 has been increased to 3400MT/day in 2010-11. The worldwide increase in use of glass has become a matter of concern both from human safety and energy point of view. Energy aspect has been taken care of and covered under the Energy Conservation Building Code 2007 (ECBC) brought out by Bureau of Energy Efficiency, Ministry of Power, Govt. of India. CCPS has also partnered with International Institute of Energy Conservation (IIEC) in developing ECBC by BEE. Therefore it is very important that glass use should be safe, appropriate and suitable which does not cause human injury or threat to human life.

Worldwide statistics show rising in glass use in buildings resulted in increased injuries due to impact breakage and falling glass. In fact, in other countries the process and action initiated long back to reduce glass related injuries and ensure human safety while using glass in building, for instance in 1960s first Standard including American National Standard Z97.1 was initiated by the glass industry. In 1972, Consumer Product Safety Commission (CPSC) was established and consumer product safety act was passed and promulgated. In 1977, CPSC standard 16 CFR part 1201 was enacted by federal government and was made mandatory for all parts of the United States, Australian standard was made compulsory in 1991, in United Kingdom standard came in existence sometime in early 1990s, in Mexico in 2001 and other countries in Europe, Singapore, China, Hong Kong have also controlled glass use.

However, in India no guidelines, standards/byelaws governing use of glass in buildings existed till 2007. In fact even the National Building Code 2005 which serves as a Model Code for adoption by most departments and agencies involved in building construction is completely silent on this issue. Even major construction departments in the country do not have any documented or specified guidelines to refer to enable them to follow or include in their specifications architectural drawings, tender documents etc to ensure safe use of glass in buildings. Prevailing Building Bye Laws adopted by the local bodies also did not have any reference or conditionality in their documents in this regard. In the present scenario this vital issue can not be overlooked

or ignored and needs to be taken up internationally to adopt procedures with consensus approach.

## Consensus approach - A Way towards more effective Standards in the Building Industry

India is witnessing new technologies and products flooding the building market. It is nearly an impossible task for the government agencies to develop standards for all of them. In such a scenario, to evolve standards through Public Private Participation mode adopting consensus method is the only way forward to safeguard the interests of the consumers, professionals, responsible producers and contractors

**Consensus standards** - though a new term in India, but has already become one of the most effective ways in many parts of the world to promote and produce, accepted standards for products and services.

As per the National Technology Transfer and Advancement Act of United States, the consensus standard is defined as:

“A standard developed by technical or professional societies or by national and international standards-setting organizations according to a well-defined procedure for consensus agreement among representatives of various interested or affected individuals, companies, organizations and countries. A consensus standard is usually referred to as an industry, national, or international standard depending upon the scope of the organization that establishes and promulgates the standard.”

## Advantages of Consensus Standards

When compared to government regulations and procedures, consensus standards have several advantages which include the following:

- i. Fewer procedural burdens;
- ii. Consensus method;
- iii. Voluntary nature allows users to adapt provisions to meet unusual circumstances;
- iv. Much lower development cost and time consuming.

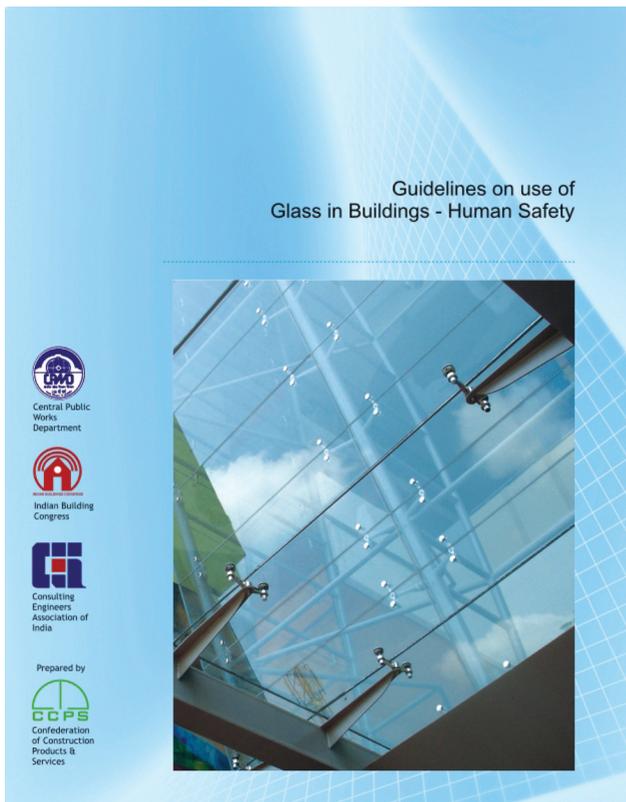
These advantages lead to authoritative documents that can be quickly developed and modified, appeal to common sense, are flexible in application, and are cost effective when compared to the state regulatory processes.

When we know and anticipate that something will create an injury and that it seems conceptually evident that injury may occur, it would be unfair to wait until a number of people have lost their lives, or sacrificed their limbs, before we attempt to prevent those accidents.

## Guidelines on Use of Glass in Buildings - Human Safety

Considering the utmost importance and need for having guidelines, standards governing use of glass in building, Confederation of Construction Products and Services (CCPS) - a nonprofit organization took lead and brought out “Guidelines on Use of Glass in Buildings - Human Safety” through PPP mode adopting consensus method by constituting Steering Committee involving experts from Central & State Govt. departments including M/o Urban Development (GOI), Central PWD, various PWDs, major municipalities, leading architects and engineers, glass manufacturers & processors and other stake holders from across the country and outside.

Four meetings of the Steering Committee were organized to finalize the Guidelines at Delhi, Mumbai, Bangalore and Delhi on 16<sup>th</sup> April 2007, 27<sup>th</sup> July 2007, 25<sup>th</sup> August 2007 and 2<sup>nd</sup> November 2007 respectively.



“Guidelines on Use of Glass in Buildings – Human Safety” brought out by CCPS

The recommendations of the Guidelines were based on test standards as outlined by Bureau of Indian Standards (BIS) and conform to the IS 2553 (Part 1): 1990 – Safety Glass – Specification, General Purpose and suggest how to regulate glass in relation to human safety by either, restricting use of glass or specifying Safety Glass at critical locations where chances of injury due to glass breakage were considered high. Consideration for manifestation, fire fighting and smoke exhaust was also included.

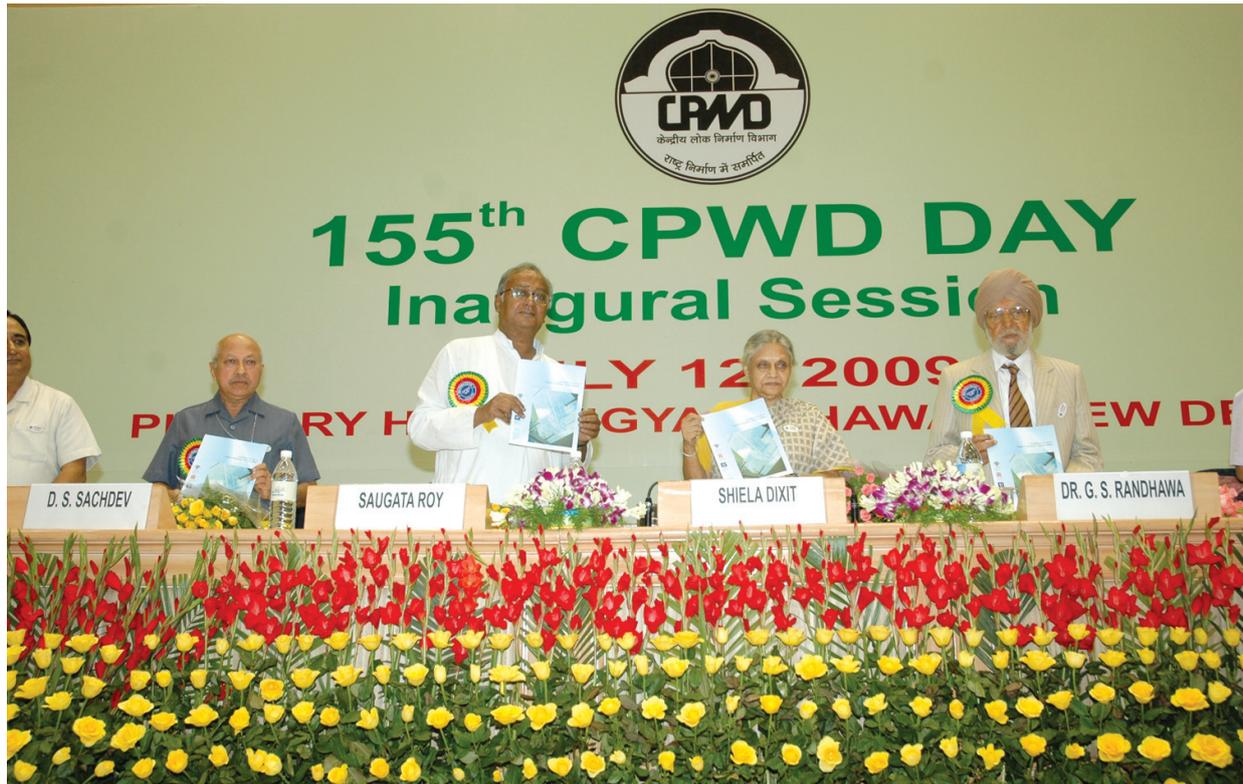
The Guidelines were further reviewed by an Expert Committee constituted under the Chairmanship of Mr. P. B. Vijay, former Director General, Central PWD and having representations from CPWD, Indian Building Congress (IBC), Consulting Engineers Association of India (CEAI), CCPS and other stake holders

## Propagation and Implementation

CCPS has made all efforts for implementation and propagation of the guidelines in public interest amongst the State and Central Government

departments, policy makers, practicing engineers, architects, builders, developers, processors, fabricators, in the country through meetings, contacts, e-mail, writing letters, distribution of Guidelines, organizing workshops, giving presentations, participating in national and international seminars & exhibitions, electronic & print media, press conferences etc. The Glass Standard prepared by CCPS is an exemplary assignment which is not only a referral publication giving opportunity for selection of right type of glass at critical locations in the buildings or suggesting safety measures but also a mandatory document as declared so far by 13 States, Central & State Government departments and PSUs. Following is the status of propagation, implementation and achievements.

1. Planning Commission has also taken note of increased use of glass in buildings that too without following safety norms or guidelines and a meeting was called by Mr. Anwarul Hoda, the then Hon'ble Member (HUD), Planning Commission on 12.12.2008 in Yojana Bhawan, where CCPS gave a presentation on the Guidelines. Hon'ble Member expressed his concern at the absence of standards and guidelines on safety while using glass in buildings in the country and observed that Municipal Bodies are concerned about sanctioning of building plans but safety aspect while using glass in buildings is totally missing. Member stressed the need for inclusion of conditionality in Building Byelaws to ensure human safety while using glass in buildings and State Governments should come forward for implementation of the Byelaws.
2. Adviser (HUD), Planning Commission has addressed a letter No. PC/H/4/3/2006-HUD-Vol. IV dated 4<sup>th</sup> Feb, 2009 and 26<sup>th</sup> November 2009 to Principal Secretaries/Secretaries of HUD Deptt. of all States/UTs requesting to initiate action for ensuring safe use of glass in buildings by insisting on certain conditions.
3. On the occasion of 155<sup>th</sup> CPWD DAY, these Guidelines were released at Vigyan Bhawan, New Delhi on 12<sup>th</sup> July 2009 in the presence of MRs Shiela Dixit, Hon'ble Chief Minister, Govt. of Delhi, Chief Guest, Mr. Saugata Roy, Hon'ble Minister of State for Urban Development and more than thousand dignitaries and participants.



Release of Guidelines by MRs Shiela Dixit, Hon'ble Chief Minister, Govt. of Delhi, Mr. Saugata Roy, Hon'ble Minister of State for Urban Development on 12<sup>th</sup> July 2009 at Vigyan Bhawan, New Delhi

4. Central PWD has mandated these Guidelines and issued an O M No. 129/SE(TAS)/2007/212 dated 04.08.2009 directing its follow up with immediate effect in the department and in PWD, Govt. of National Capital Territory of Delhi to ensure safe use of glass.
5. Town & Country Planning Deptt., Govt. of Andhra Pradesh and Greater Hyderabad Municipal Corporation had recommended for insisting conditions based on the CCPS guidelines vide their letters dated 20.08.2008 and 31.12.2008 respectively to the Principal Secretary, MA & UD Department, Govt. of Andhra Pradesh.
6. Government of Andhra Pradesh has also issued G.O.Ms. No. 205 dated 27.02.2009 addressing to all Municipal Commissioners /Vice Chairmen of Urban Development Authorities/ Commissioners of Municipal Corporations in the State, Hyderabad Metropolitan Development Authority, Hyderabad, Greater Hyderabad Municipal Corporation, Director of Municipal Administration and Director of Town & Country Planning to follow and ensure the guidelines and conditions whenever permissions are accorded for usage of glass in buildings.
7. Greater Hyderabad Municipal Corporation has issued a Circular No. Glass/TPS/HO/GHMC/2009 dated 10.11.2009 to indicate as one of the condition on usage of glass in the plans while releasing the building permissions.
8. Govt. of Rajasthan has issued Office Order No. F.10(7)UDD/3/2009 dated 18.01.2011 to PWD, Rajasthan Housing Board; Deptt. of Local-self Govt. Rajasthan Housing Board; Jaipur Development Authority; Jodhpur Development Authority; Urban Improvement Trusts, Udaipur, Bhilwara, Bikaner, Kota, Ajmer, Alwar, Bhiwari, Sranganagar, Jaisalmer, Abu Road & Bharatpur; Chief Town Planner and Director, Local Bodies, for implementation of Guidelines.
9. Town Planning Department, Govt. of Rajasthan, Office Order No. TPR 8265:08:54/7553-7568 dated 11.05.2011 to Chief Town Planner (NCR); ACTP (East/West); STPs and DTPs.
10. Rajasthan Housing Board, Jaipur Office Order No. 176 dated 08.03.2011
11. Haryana Public Works (B&R) has issued Memo No. 5535-47/WI dated 19.08.2011 to follow the Guidelines in the department in its true letter and spirit while planning and approving buildings to ensure safe use of glass.



12. Govt. of Delhi, PWD has issued OM No. E-in-C/W/NMET/2010/5708 dated 25.11.2010 to ensure that these guidelines are followed scrupulously to ensure safe use of glass in buildings. The OM is forwarded to Principal Secretary (PWD), Govt. of National Capital Territory of Delhi, all Chief Engineers, Superintending Engineers and Executive Engineers of GNCTD.
13. Delhi Development Authority has also issued OM No. EM/(10)2010/Circular/Vol.III/4671 dated 29.11.2010 to ensure to follow these guidelines in the DDA.
14. Chief Engineer, PWD, Govt. of Manipur has issued necessary instructions in the State vide letter No.12/10/2007-CE/819 dated 5.8.2008.
15. Chief Engineer, Andaman PWD, Andaman & Nicobar Adm. Issued OM No. Arch-07/2009/3828 dated 21<sup>st</sup> December 2009.
16. Airport Authority of India issued Technical Instruction No. 86 vide No. AAI/Member (Plg)/Tech-Inst./2012 dated 20<sup>th</sup> January 2012.
17. National Buildings Construction Corporation Ltd. (NBCC) implemented Guidelines and included as part of technical specifications of NBCC tender documents vide No. AGN/Safety/2011-12/311 dated 27<sup>th</sup> January 2012.
18. Metropolitan Commissioner, Mumbai Metropolitan Region Development Authority (MMRDA) has recommended to Govt. of Maharashtra vide letter dated 14<sup>th</sup> May 2010 to put certain conditions mentioned in the Guidelines in DCRs on use of Glass in buildings to ensure human safety.
19. Bureau of Indian Standards (BIS) has decided to develop Indian Standard on Use of Glass in Buildings in the Sectional Committee CED 13 meeting held on 05.11.2008. Based on CCPS Guidelines, "Draft Code of Practice for Use of Glass in Buildings - Safety related to human impact: Part 4" has been prepared and is ready for wider circulation before printing.
20. CCPS has organized 13 Workshops at the various places in the country for the officers, engineers and architects of CPWD, Delhi Development Authority, Airport Authority of India, PWD Delhi, Greater Hyderabad Municipal Corporation, Punjab Urban Development Authority, Municipal Corporation Delhi, PWD (Common Wealth Games Zone-I), Local Self



Presenting Guidelines to Lt. General, (Retd) Bhopinder Singh, PVSM, Hon'ble Lieutenant Governor, Andaman & Nicobar Islands

Govt. Rajasthan, CPWD NZIII, Jaipur, L & T, Chennai, Town Planning Deptt. Rajasthan and Haryana PWD & other Departments to acquaint them about the salient features, importance of its implementation and selection of appropriate glass at critical locations

21. Participated and presentations were also given at a number of national and international conferences, seminars, exhibitions etc.

## Task Ahead

Fatal accidents due to glass impact are reported in media from time to time which could have been averted if appropriate glass was used at critical locations. (Cheap Glass Culprit in Boy's Death - Ahmedabad Mirror- 12 Nov. 2008 and Victim allegedly walked through a glass door at Naaz Saloon, Sector 20-D, Chandigarh succumbed to death reported in Tribune-27 July 2009). Therefore, it is very important that the Central/State Governments/ UT Adms., Green Building Rating Agencies, IGBC, GRIHA, Builders, Developers etc should come forward to ensure safe use of glass in buildings by insisting conditionality through GO/OM/circulars or inclusion of recommendations of Guidelines in building byelaws and specifications/manual as is initiated by Govt. of Andhra Pradesh, Govt. of Rajasthan, Central PWD, NBCC, Airport Authority of India, GHMC, DDA, Govt. of Delhi PWD, PWD Haryana etc.

When we know and anticipate that something will create an injury and that it seems conceptually evident that injury may occur, it would be unfair to wait until a number of people have lost their lives, or sacrificed their limbs, before we attempt to prevent those accidents.

Now with the availability of these Guidelines and implemented by a number of States and vital departments, the officials, architects, engineers, designers, builders, developers and even users in the country have no excuse to show ignorance for insisting or selecting right type of glass and even examining the already fitted glasses in the buildings for its appropriateness or introducing safety measures as suggested in the Guidelines to ensure human safety.

Needs wider publicity, propagation and issue of necessary OMs/Orders/ GOs by State Govts./ UT Adms. to get the implementation of Guidelines by Local Bodies, Development Authorities, Corporations etc and inclusion of conditionality in

Building Byelaws , safety glass items in Schedule of Rates of Govt. Deptts. and incorporation in curriculum and syllabus of technical institutions in the country.

## Commitment & Assurance by CCPS

CCPS is committed to propagate safe use of glass in buildings to ensure human safety in public interest and would be very glad to provide any further information or assistance in this venture and offer to organize one/half day capacity building workshop for the interested people, groups, departments or organizations on the subject at pre decided terms, venue and date and assure for all cooperation and assistance.

## Summary of Guidelines

**1.0 Scope** - The scope of these guidelines covers minimum safety requirements subjected to various kinds of human impact, precautions against risk of fall and falling glass.

**2.0 Safety Glass** - Safety glass shall be of four types as follows:

- a) Toughened Safety (Tempered) Glass (TS)



Guidelines being presented to Ms. Selja, Hon'ble Minister for Housing & Urban Poverty Alleviation and Culture, Govt. of India

- b) Toughened Float Safety Glass (TF)
  - c) Laminated Safety Glass (LS)
  - d) Laminated Float Safety Glass (LF)
- Glass at 'b' and 'd' shall be preferred.

**3.0 Critical Locations** - Critical locations are parts of a building most likely to be subjected to accidental human impact. Where any glazing is within 1.5 metre above the floor level of building, it is considered likely to be subjected to human impact and hence, shall comply with the human impact safety requirements as laid down below. Safety glazing material should also be used:

- a) Where there is danger of falling infill glass materials from overhead glazing
- b) Where there is danger of falling due to a change in floor level
- c) In case of balustrades, stairs and floor slabs However, if the smaller dimension of pane is 250 mm or less and its area is 0.50 sqm or less, glass not conforming to safety requirements can also be used.

**3.1 Classification of Critical Locations** - The critical locations with appropriate types of glass allowed for use, is listed in the following five cases:

Case 1: Glass used as Vertical Walls (not likely to be subjected to Human Impact)

- Hs  $\geq$  0.75 m or with Residual Protection
- Type of Glass to be used: Any glass (Safety Glass not mandatory)

Case 2: Glass used as Vertical Walls (Human Impact but no risk of fall)

- Hs < 0.75 m and Hf  $\leq$  1.5 m
- Type of Glass to be used: Safety glass (TF or LF)

Case 3: Glass used as Vertical Walls (Human Impact and risk of fall both)

- Hs < 0.75 m and Hf  $\geq$  1.5 m
- Type of glass to be used: Safety glass (LF preferred)

Case 4: Glass used in Horizontal or sloped glazing (Risk of fall)

- Type of glass to be used: Laminated safety glass (LF)

Case 5: Glass acting as a balustrade, parapet or a railing (Human Impact and risk of fall both)

- Type of glass to be used: Laminated safety glass (LF)

Residual protection is the protection provided to avoid the impact of human-being to glass. e.g. sill

structure or transom, balustrade or railing, or grill inside.

Hs = Sill height, Hf = Falling height in case of change in level between the two sides of glass.

**4.0 Manifestation** - Clear glass panels capable of being mistaken for an unimpeded path of travel should be marked to make them visible by incorporating manifestation. Manifestation employed shall be in form of opaque band of size not less than 20 mm in height and located at vertical distance from floor level to not less than 700 mm from upper edge of band and not more than 1200 mm to lower edge of the band. The manifestation shall preferably be permanent, e.g. of the glazing, but alternatively, if applied materials are used they shall be durable and not easily removed.

**5.0 Identification of Safety Glass** - All Safety Glass shall be indelibly and distinctly marked with type of glass, name or logo to identify the manufacturer, thickness of glass and BIS certification mark. Stickers are not permitted for these markings.

**6.0 Safety Glass Test requirements** - Glasses shall satisfy the relevant resistance to shock test, fragmentation test, warp test for TS and TF glass and LS and LF glass shall comply with light stability test, boil test and fracture and adhesion test in accordance with IS 2553 (Part 1).

**7.0 Precautions** - The following precautions should be taken to reduce the injuries that can result from glass breakage by:

- a) Selecting glass of a suitable type, thickness and size,
- b) Enhancing the person's awareness of the presence of glass by making glass visible (Manifestation)
- c) Minimizing manual handling of large pieces of glass during installation.
- d) In case of external laminated glass facades, openable portions have to be left at regular distances as required for fire fighting and smoke exhaust.

*(The Guidelines and copies of the GO/OMs can be downloaded from the web site ([www.ccpsindia.com](http://www.ccpsindia.com)) or contact CCPS office, S1 & S2, 2<sup>nd</sup> Floor, Abhishek Tower-D2, Alaknanda Commercial Complex, New Delhi 110019, Phone: +91 11 26023615, Telefax: +91 11 26021709, e-mail: [ccps@ccpsindia.com](mailto:ccps@ccpsindia.com))*