

# **Pakistan Accord Building Standard**

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## Part 1: Scope and Application

### 1.1 Scope.

**1.1.1 Title.** The Pakistan Accord Building Standard shall be referred to herein as “the Standard” or “this Standard.”

**1.1.2 Danger to Life from Fire.** This Standard addresses and establishes minimum criteria to minimize danger to life of the building occupants from the effects of fire including smoke, heat, and toxic gases created during a fire.

**1.1.3 Danger to Life from Structural Collapse.** This Standard addresses and establishes minimum criteria for the evaluation and protection from danger to life from building collapse.

**1.1.4 Danger to Life from Electrical Hazards.** This Standard addresses and establishes minimum criteria for the protection from danger to life from electrical hazards.

**1.1.5 Danger to Life from Boiler Accidents.** This Standard addresses and establishes minimum criteria for the protection from danger to life from boiler related accidents.

**1.1.6 Danger to Life from the Use of Hazardous Substances.** This Standard addresses and establishes minimum criteria for the protection from danger to life from storage, use and handling of hazardous substances.

### 1.2 Application.

**1.2.1** This Standard shall apply to all buildings and structures (including any ancillary structures on site) used for producing garments and textiles for company signatories in Pakistan subject to the installation of major equipment, changes of use and occupancy, construction, additions, alterations, movements, enlargements, replacements, repairs, maintenance, removal, and demolition.

**1.2.2** This Standard shall apply to both new construction and existing buildings and structures as specifically outlined in this Standard.

### 1.3 Purpose.

The purpose of this Standard is to establish a common set of minimum requirements that provide a uniform and effective method for assessing fire, structural and other aspects of building safety in new and existing garment and textile factories utilized by suppliers covered under the Pakistan Accord.

### 1.4 Disclaimer.

**1.4.1** The technical requirements of this Standard are intended for use by professional structural engineers, fire safety specialists, electrical engineers, mechanical engineers

and boiler specialists who are competent to evaluate the significance and limitation of its content.

**1.4.2** Notwithstanding the provisions provided in this Standard, nothing in this Standard precludes a Factory Owner's responsibility to abide by the requirements under the federal and provincial laws of Pakistan.

## **1.5 Definitions.**

**1.5.1** All definitions as stated in the Building Codes of Pakistan (Fire Safety Provisions-2016 and Seismic Provisions-2007) apply to this Standard, except as specifically supplemented or changed herein. Additional definitions are provided with each part of this Standard.

**1.5.2 Factory.** A Factory is a facility where product is produced or processed by/for a supplier and is listed with the Pakistan Accord by a company signatory. A supplier is the contractual partner of a company signatory. A supplier can own or use more than one Factory. "Supplier" and "Factory" are used interchangeably in this Standard and the Pakistan Accord, and therefore jointly defined as "Factory" in this document. For purposes of the Pakistan Accord, a Factory includes Cut Make & Trim Factories, Integrated Units and Fabric Mills as defined in the Pakistan Accord Factory Disclosure Protocol.

**1.5.3 Chief Safety Officer (CSO).** Means the Chief Safety Officer of the Pakistan Accord.

**1.5.4 Factory Owner.** A Factory Owner owns or has a license to operate a factory for the production and processing of textile and garments.

**1.5.5 International Accord.** Means the International Accord for Health and Safety in the Textile and Garment Industry.

**1.5.6 Pakistan Accord.** Means an International Accord country-specific safety program in Pakistan, the Pakistan Accord for Health and Safety in the Textile and Garment Industry.

## **1.6. References.**

**1.6.1 General.** The documents listed in this section or referenced in this Standard and the portions thereof are considered part of the requirements of this Standard to the extent of each such reference. The documents not listed in this section but referenced in the Pakistan Building Code are also considered part of the requirements of this Standard to the extent of each such reference. The Pakistan Building Code shall apply except as otherwise indicated in this Standard.

### **1.6.2 Pakistani Laws and Rules**

Building Code of Pakistan (Fire Safety Provisions-2016).

Building Code of Pakistan (Seismic Provisions-2007).

The Boilers and Pressure Vessels Ordinance, 2002.

The Punjab Community Safety Act, 2021.

- Punjab Community Safety Building Regulations 2022

### **1.6.3 Standards and Guidance.**

Documents not listed in this section but referenced in the Pakistan Building Code are considered part of the requirements of this Standard to the extent of each such reference. The following organisations address related safety issues and may be helpful in developing design solutions: International Code Council (ICC), FM Global, NFPA and British Standard Institute (BSI).

### **1.6.4 NFPA publications.** National Fire Protection Association, 1 Battery March Park, Quincy, MA 02169-7471 USA.

- 1.6.4.1 NFPA 51B, Standard for Fire Prevention During Welding, Cutting, and Other Hot Work, 2014.
- 1.6.4.2 NFPA 400, Hazardous Materials Code, 2013.
- 1.6.4.3 NFPA 2800, Standard on Facility Emergency Action Plans, 2023.

### **1.6.5 ACI publications.** American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331 USA.

- 1.6.5.1 ACI 228.1R, In-Place Methods to Estimate Concrete Strength, 2003.

### **1.6.6 AISC Publications.** American Institute of Steel Construction, One East Wacker Drive Suite 700, Chicago, IL 60601 USA.

- 1.6.6.1 AISC Code of Standard Practice.

### **1.6.7 ASCE Publications.** American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191 USA.

- 1.6.7.1 ASCE 7. Minimum Design Loads for Buildings and Other Structures, 2010.

### **1.6.8 ASME Publications.** American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016 USA.

- 1.6.8.1 ASME A17.1 Safety Code for Elevators and Escalators, 2010.

### **1.6.9 ASTM Publications.** ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428 USA.

- 1.6.9.1 ASTM A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products, 2012.
- 1.6.9.2 ASTM C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, 2013.
- 1.6.9.3 ASTM C823, Standard Practice for Examination and Sampling of Hardened Concrete in Constructions, 2012.

- 1.6.9.4 ASTM – C39 /39M – 12a, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens, 2012.
- 1.6.9.5 ASTM- C856, Standard Practice for Petrographic Examination of Hardened Concrete, 2011.
- 1.6.9.6 ASTM - C295, Standard Guide for Petrographic Examination of Aggregates for Concrete, 2012.
- 1.6.9.7 ASTM - C457, Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete, 2011.
- 1.6.9.8 ASTM E 136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C, 2009b.
  
- 1.6.10 International Engineering and Technology (IET),** BS 7671, 18th Edition including amendments.
  
- 1.6.13 International Mechanical Code.** 2021 as published by the International Code Council (ICC)

## Part 2: Administration

### 2.1 General.

This Standard, including establishing inspection protocols and conducting factory compliance inspections, will be administered by the Chief Safety Officer.

### 2.2 Adoption of the Building Codes of Pakistan

Subject to the amendments set out in the Schedules 1 and 2 to this Standard, the Building Code of Pakistan (Fire Safety Provisions – 2016) and the Building Code of Pakistan (Seismic Provisions – 2007) are adopted as the building codes for the Pakistan Accord.<sup>1</sup>

### 2.3 Adoption of the 18th Edition of the International Engineering and Technology (IET) Wiring Regulations (BS 7671 including amendments)

The 18<sup>th</sup> Edition of the IET Wiring Regulations (latest revision) is adopted as the safety code for existing and new electrical installation and wiring under the Pakistan Accord. NFPA 70 as referenced in the Pakistan Building Code is therefore not adopted as the applicable safety code for this Standard.

Moreover, a covered Factory will apply, in their entirety, the ANSI/NETA or NFPA 70B standards to ensure all electrical equipment and systems are installed in accordance with design specifications and operational, including as it relates to thermographic testing

### 2.4 Adoption of NFPA 400 Hazardous Materials Code

The NFPA Standard 400 is adopted by the Pakistan Accord as it relates to the use, storage, and handling of chemicals or substances that are classified as a physical hazard material or a health hazard material, whether the chemical or substance is in usable or waste condition.

### 2.5 Adoption of 2021 International Mechanical Code (IMC)<sup>2</sup>

For the purposes of installation, inspection and maintenance of steam boiler and other pressure vessels, the 2021 International Mechanical Code (IMC) published by the International Code Council is adopted as the required boiler and pressure vessel standard of the Pakistan Accord.

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<sup>1</sup> Available at: <https://pec.org.pk/downloads-documents/building-code-of-pakistan/>

<sup>2</sup> Available at: <https://codes.iccsafe.org/content/IMC2021P3>

# **Schedule 1**

## **Fire Safety**



## **Section 1: Modifications to the Building Code of Pakistan (Fire Safety Provisions – 2016)**

- 1.1** All references to “NFPA or other acceptable standard” in the Building Code of Pakistan (Fire Safety Provisions – 2016) are to be read as the NFPA standard only.
- 1.2** Garment and textile factories would normally be considered as what Pakistan Building Code (Fire Safety Provisions – 2016) refers to as “industrial, ordinary hazard” occupancies.
- 1.3** 9.3.2.28 is deleted. The requirements for fire sprinkler systems are applied to existing garment and textile factory buildings as follows:
  - 1.3.1** Those where there is an ‘occupied floor’ more than fifty (50) feet above the lowest level of fire department vehicle access.<sup>3</sup>
  - 1.3.2** Where automatic sprinkler systems are required, they shall meet the requirements of NFPA 13.
  - 1.3.3** All internal car parks below ground level shall have an automatic water sprinkler system meeting the requirements of NFPA 13 regardless of building height.
- 1.4** Clause 10.9.1.8.3 is deleted. Lockable exit doors are an unacceptable risk regardless of internal factory policies about when they are to be locked or unlocked.
- 1.5** Clauses 10.9.1.5.3, .4 and .5 are deleted. Only swinging doors as required by clauses 10.9.1.5.1 and .2 provide an acceptable level of risk. Horizontal sliding doors would only be permitted in administrative/office areas where the population does not exceed 10 persons.
- 1.6** Clause 10.10.3 is modified by removing “For other than existing means of egress”. The principle of adequate exit capacity applies equally to new and existing buildings.
- 1.7** Clause 10.13.1.2 and clause 10.13.2 are deleted. Exit termination to the exterior as described in clause 10.13.1 is the only acceptable option, except as described in Section 1.8. Roof top discharge is an unacceptable risk.
- 1.8** Sentence 10.13.3 is modified by adding clauses as follows:

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<sup>3</sup> In accordance with the Punjab Community Safety Act 20213 (available at: <http://punjablaws.gov.pk/laws/2817.html>) and Building Safety Regulations 2022 for existing industrial buildings (available at: <https://rescue.gov.pk/BuildingRegulations.pdf>).

10.13.3.(4) Automatic sprinkler protection is provided throughout the level of exit discharge or portion of the level of discharge separated from non-sprinklered portions of the floor by fire barriers with the same fire resistance rating as the exit enclosure;

10.13.3.(5) The interior discharge is not through a storage or hazardous occupancy;

10.13.3.(6) The entire area of the level of exit discharge is separated from areas below by construction having a fire resistance rating not less than that required for the exit enclosure.

**NOTE:** *Re-entering an unprotected area of the building after being in a protected exit enclosure such as a fire rated stairwell is a risk that must be mitigated with added fire protection measures in the floor area.*

- 1.9** “Labelled”, “Listed/approved”, shall be taken to mean Underwriters Laboratory (UL) labelled, listed/approved unless otherwise approved by the Pakistan Accord’s Chief Safety Officer (e.g., Warnock Hersey (Intertek), Factory Mutual, Certifire (Warrington), AENOR (Spain), British Standards Institution, Swedish Insitute for Standards, CSTB (France), VdS).

## **Section 2: Human Element Programs**

**2.1 Fire Safety Director.** Means a person responsible for developing and implementing fire safety plans that address fire safety systems to protect life safety in the factory.

**2.1.1 Duties.** The duties of the Fire Safety Director shall include the following:

- 1) Establish external rally points and communicate to all employees in the building.
- 2) Fire department pre-planning.
- 3) Conduct safety inspections as outlined in 2.9.
- 4) Ensure all testing of fire protection equipment is conducted in accordance with 2.10.

**2.2 Fire Drills**

**2.2.1** Fire drills shall be conducted on as required by AHJ, and as a minimum on a twice annual basis for all garment and textile factories.

**2.2.2** Fire drills shall be conducted under the direction of a Fire Safety Director.

**2.3 Evacuation Plan.**

**2.3.1** The Fire Safety Director shall develop a fire evacuation plan for each building.

**2.3.2** Fire evacuation maps shall be posted at the entrance to each exit stair and final exits to the outside.

**2.3.3** The evacuation plan shall include provisions to assist physically disabled persons in accordance with NFPA 2800 “Standard on Facility Emergency Action Plans” 2023. A list of all employees with physical disabilities shall be kept by the Fire Safety Director.

**2.4 Hot work permit.**

**2.4.1** A hot work permit system program shall be enacted for all garment and textile factories in accordance with NFPA 51B.

**2.5 Smoking.**

**2.5.1** Smoking shall be prohibited in any garment and textile factory building, separate storage building, or any building.

**2.5.2** Signs shall be posted in Urdu and English at all building entrances.

**2.5.3** If an Owner creates a designated smoking area outside the buildings, information on the location of these designated areas shall be posted on the signs required in 2.5.2.

**2.6 Housekeeping.**

**2.6.1** Policy. Establish written corporate and plant policies on housekeeping to ensure scheduled cleaning for floor, wall, ceiling, supply and return air ventilation systems. Promptly reschedule skipped cleanings. Provide a documented line of authority for authorizing a cleaning delay and rescheduling. As a general rule, the accumulation of loose fluffy lint and/or combustible dust is unacceptable.

**2.6.2** Maintain electrical systems in good working order and keep free of lint buildup to reduce the potential for ignition. This includes cleaning inside junction boxes, buses, trays, tunnels, etc.

**2.6.3** Egress. All means of egress shall be kept unobstructed and clear at all times.

**2.6.4** Daily inspections. These inspections shall look for egress maintenance, condition of fire doors, storage in aisle ways, excess storage, smoking, hot work and other fire-safety related items.

**2.6.5** Fire doors shall be tested to ensure that they are properly self-closing and latching.

**2.7 Storage practices.**

**2.7.1 Management of Operating Loads**

Factory Owners shall ensure that at least one trained professional individual is assigned to each factory facility to manage and monitor the operational loadings of the building, including the following:

- 1) Storage of work materials

- 2) Storage of work products
- 3) Location and weights of fixed and non-fixed equipment

**2.7.2 Cutting tables.** Storage underneath the cutting tables shall be kept clear of combustibles at all times.

**2.8 Safety Inspections.** A safety inspection program shall be initiated and conducted on a quarterly basis. This program shall be conducted under the direction of the Fire Safety Director. These inspections shall look for egress maintenance, condition of fire doors, storage in aisle ways, excess storage, smoking, hot work and other fire-safety related items. Records of these inspections shall be kept for inspection review.

**2.8.1 Construction inspections.** An additional safety inspection program shall be initiated under the direction of the Fire Safety Director for any construction that occurs in an occupied facility.

**2.8.2 Doors tested.** Fire doors shall be tested on a quarterly basis to ensure that they are properly self-closing and latching. They shall also be checked for the proper label and verification that the door has not been perforated and/or damaged in any way.

**2.9 Maintenance of fire protection equipment.**

**2.9.1 Automatic suppression systems.** Inspection, testing and maintenance in accordance with NFPA 25 shall be conducted on all water-based fire protection systems.

**2.9.2 Fire alarm and detection systems.** Inspection, testing and maintenance in accordance with NFPA72 shall be conducted on all fire alarm systems.

**2.9.3 Fire extinguishers.** Fire extinguishers shall be inspected, tested, and maintained in accordance with NFPA 10.

**2.10 Equipment.**

**2.10.1** Establish a maintenance, cleaning and lubrication schedule for all equipment. The maintenance and cleaning schedule will vary with type of fiber processed and the equipment used. Lubricate equipment in accordance with manufacturer's recommendations. Review plant fire incident records to determine whether cleaning or equipment maintenance was a factor, and increase frequency as needed.

**2.11 Electrical maintenance.**

**2.11.1 Testing of emergency lighting.** Emergency lighting provided by battery backup shall be tested on a monthly basis.

**2.11.2 Generators.** Generators used for emergency or standby requirements of this Standard shall be inspected, tested, and maintained in accordance with NFPA 110.

# **Schedule 2**

## **Structural Safety**

## Existing Building Structural Assessment and Design

### 1.1 Applicability of Building Code

- 1.1.1 New factories shall comply with the more stringent requirements of this Standard and the Building Code of Pakistan (Seismic Provisions – 2007) plus code updates and jurisdictional circulars as they may be issued from time to time.
- 1.1.2 Existing factory buildings are those that are in current use in the Pakistan garment and textile industry at the adoption of this Standard on 13 September 2023.
- 1.1.3 For any substantial extension of an existing factory, the extended portions and the entire newly-configured factory structure shall comply with the requirements of Building Code of Pakistan (Seismic Provisions – 2007). Any other relevant laws and procedural regulations not mentioned in this Standard also applies.

*Interpretive Guideline: Regardless of when a factory was constructed, the structural impact of any expansion on the entire structure must be analytically evaluated and confirmed by a qualified structural engineer.*

- 1.1.4 Additions to Existing Structures. When an existing building or structure is substantially extended or otherwise altered, all portions thereof affected by such cause shall be strengthened, if necessary, to comply with the safety and serviceability requirements provided in the Building Code of Pakistan (Seismic Provisions – 2007).
  - 1.1.4.1 This Standard utilizes the Building Code of Pakistan (Seismic Provisions – 2007) (modified as noted herein) as the applicable standard for new factory construction and for all expansions or modifications to existing factories. When and if a replacement to the Building Code of Pakistan (Seismic Provisions – 2007) is issued by the applicable Code-developing body, it will be adopted as the applicable technical standard for new factories and all expansions or modifications to existing factories.
  - 1.1.4.2 At the discretion of the CSO, a substantial expansion will be interpreted to mean any new floor or roof levels or horizontal floor additions or similar new structure.

### 1.2 Structural Integrity of Existing Factory Buildings:

- 1.2.1 Every existing factory building must demonstrate a minimum degree of structural integrity as confirmed by credible original structural documentation and a Preliminary Structural Assessment performed by a Pakistan Accord structural engineer, or QSEC.

*Interpretive Guideline: The intent of Section 1.2 is that every existing factory must evidence a reasonable level of structural integrity regardless of when it was constructed and regardless of the availability of credible structural documentation. This Standard requires the analytical confirmation of structural capacity of key gravity and lateral load-*

*bearing elements for the actual in situ conditions in the factory by a qualified structural engineer working on behalf of the Factory Owner. Taken in tandem with acceptable observed structural performance of the overall structure, the Preliminary Structural Assessment may be accepted as evidence of a reasonable level of structural integrity. For factory buildings with noted concerns or unacceptable findings from the Preliminary Structural Assessment, a higher level of structural investigation, analysis, and ongoing inspections may be required.*

- 1.2.2** Existing factory buildings and components thereof shall be assessed to confirm design adequacy to support all loads, including dead loads as they may occur and live loads as they may be imposed on the factory during its lifetime, without exceeding the allowable stresses or design strengths under applicable factored loads and load combinations for the materials of construction in the structural members and connections in accordance with the provisions of the Building Code of Pakistan (Seismic Provisions – 2007), except as specifically modified in this Standard.

***Interpretive Guideline:** Structures must have analytically determined or empirically-determined structural capacity to support all the imposed loads including occupants, equipment, water tanks, and storage loads without overstressing structural elements. Where the magnitude of dead loads and live loads can be determined with a high level of assurance, the applicable load factors and load combinations may be reduced as indicated in this Standard, subject to in-factory verification of the actual loads. The structural capacity of key elements must be confirmed and documented in accordance with accepted engineering design processes by qualified structural engineers.*

***NOTE:** This Standard considers day-to-day loading conditions for assessment of existing garment and textile factory buildings considering life safety against building collapse. In this consideration, only service level wind loadings are considered for reinforced concrete buildings. However, assessments should note any key seismic characteristics of buildings in the report including irregularities, soft stories, and the like. For steel structures the Building Code of Pakistan (Seismic Provisions – 2007)- specified load factors are applicable.*

**1.2.3** Structural integrity of existing factories may be confirmed by Preliminary Structural Assessment as described in Section 1.3. The Ultimate Strength design method for reinforced concrete elements and systems and the Load Factor design method for structural steel structures shall be the basis of retrofit design under this Standard.

**1.2.4 Serviceability.** Structural framing systems and components shall be designed with adequate stiffness to avoid excessive cracking, deterioration, or unsafe conditions due to deflections, vibration, or any other serviceability shortcomings.

***Interpretive Guideline:** Deflections (sagging), rotations (twisting), perceivable vibrations, or other noticeable movements of the structure shall require additional structural investigation as required by this Standard. This intent of this Standard is to focus on Life Safety concerns rather than serviceability.*

### **1.3 Preliminary Structural Assessment to Confirm Structural Integrity of Existing Factory Buildings**

***Interpretive Guideline.** It is recognized that some Pakistani factory buildings were built before or absent active enforcement of Building Code requirements. Many of these factories lack basic documentation that could provide evidence of physical design characteristics such as element dimensions, reinforcing and material strengths which could be used to readily confirm the structural safety of the factories. Recognizing that absence of structural documentation does not make a factory unsafe, this protocol provides a methodology for Factory Owners who lack appropriate documentation to provide other acceptable evidence of structural integrity.*

**1.3.1** This protocol is applicable for factories that, in the sole opinion of the Pakistan Accord structural engineer, lack complete, original, accurate, and credible structural documentation as described in Building Code of Pakistan (Seismic Provisions – 2007)

**1.3.2** The Preliminary Structural Assessment for gravity and wind actions shall include the following activities:

**1.3.2.1** Review of available documents, either original structural documents prepared in accordance with Building Code of Pakistan (Seismic Provisions – 2007) or as-built documents prepared in accordance with Section 1.2 of this Standard.

**1.3.2.2** Comparison of these documents with actual as-built conditions, including dimensional checks of samples of structural elements.

**1.3.2.3** Visual assessment of all structural elements for evidence of distress, cracking, or lack of performance.



- 1.3.2.4 Visual and analytical confirmation of floor loading in compliance with floor load plans.
- 1.3.2.4.1 Visual confirmation of performance of foundations, including absence of settlement cracking, excessive perimeter separations or settlement, or lack of floor levelness attributable to foundation settlements.
- 1.3.2.5 In assessing the load capacity adequacy of a pile foundation system under an existing factory that has performed for at least five years without indications of excessive settling, the factor of safety shall be at least 1.5.
- 1.3.2.6 Visual confirmation of clear and redundant load path for lateral loads, including diaphragms and vertical elements. Visual observations shall note any evidence of apparent cracking or other lack of performance of lateral systems under prior lateral loading.
- 1.3.2.7 In-situ non-destructive testing including reinforcement scanning, rebound hammer tests and other similar non-destructive tests as deemed appropriate by the Structural Engineer at a number of sample locations.
- 1.3.2.8 Simple structural calculations to assess the basic capacity of structural members, including:
  - 1.3.2.9 Columns and wall elements at most critical tiers, including lowest tier. Vertical elements shall be reviewed for maximum load combinations of forces due to axial and bending.
    - 1.3.2.9.1.1 Unless confirmed otherwise by scanning or other investigations, columns may be assumed to be reinforced with a maximum of 1% steel times the gross plan area of the column. Other material data assumptions to be used in the calculations can be seen in Section 1.16.
    - 1.3.2.9.2 Vulnerable or critical structural elements identified by the Pakistan Accord structural engineer including transfer girders, hangers, cantilevers, columns with high slenderness ratio, flat plate floors, and footings with inadequate thickness.
- 1.3.3** The general purpose of the Preliminary Structural Assessment, and any follow-up detailed structural assessment is to answer the following seven questions in the affirmative:
  - 1) Is the vertical load carrying system logical?
  - 2) Is the lateral load-carrying system apparent and does it have redundancy?
  - 3) Are key structural elements such as columns, slender columns, flat plates, and transfer structures satisfactory?
  - 4) Is building performance in respect to foundation settlement satisfactory?
  - 5) Is the structure free from any visible structural distress (progressive cracking) in main load-carrying members?

- 6) Is the structural strength and performance of any visible vertical or horizontal extensions acceptable?
- 7) Are credible structural documents available?
  - a. Either credible original structural document in accordance with Building Code of Pakistan (Seismic Provisions – 2007) or
  - b. As-built documents in accordance with Section 1.20 will generally suffice.

#### **1.4 Results of Preliminary Structural Assessment of Existing Factory Buildings**

- 1.4.1** If the Pakistan Accord structural engineer determines that the answers to the seven questions in Sections 1.3.3 are affirmative, the factory may be found to be acceptably structurally safe and compliant with this Standard without further structural investigations, at the discretion of the engineer.
- 1.4.2** If the Pakistan Accord structural engineer determines that the answer to one or more of the seven questions in Sections 1.3.3 are negative, the engineer may recommend and/or conduct more detailed structural assessment, investigations or analysis.
- 1.4.3** If a more detailed structural engineering assessment is not to be carried out, engineers are encouraged to conduct in-situ testing of material strengths coupled with outline calculations.

## **1.5 Detailed Structural Engineering Assessment of Existing Factory Buildings**

- 1.5.1** If the visual assessment or the Preliminary Structural Assessment indicates areas of structural concern, distressed structural members, or other lack of compliance with the requirements of this Standard, then more detailed structural investigation shall be required.
- 1.5.2** Detailed engineering assessment shall be performed on any structural member identified as distressed. The cause and extent of structural distress shall be identified by assessment and expanded to include any other affected area of structure. To accomplish this, the Factory Owner shall engage a qualified Structural Engineering Consultant (QSEC) that meets the qualifications established by the Pakistan Accord and other relevant applicable regulations to provide structural advisory services to prepare all required design confirmation and structural documentation, as described in Section 1.31.
- 1.5.3** If required, the QSEC shall prepare as-built structural documents as described in Section 1.20.
- 1.5.4** The QSEC shall ensure that there are accurate Factory Loading Plans available as described in Section 1.10.
- 1.5.5** If required, the QSEC shall conduct and document detailed structural condition assessment in accordance with the requirements of ACI 437-19 and ACI 562-21, or similar accepted engineering practice. The strength of concrete shall be assessed by core test and may be supported by rebound hammer/UPV and amounts of reinforcement shall be assessed by ferro-scanning.
- 1.5.6** If required, the QSEC shall conduct additional detailed structural condition assessments and investigations to determine the adequacy of specific structural elements, distressed structural members, or other conditions.
  - 1.5.6.1** In the case that additional detailed structural assessments are required, the QSEC shall state assumptions regarding strength and properties of key construction materials. The QSEC shall determine the material properties using section 1.16.
  - 1.5.6.2** Unless confirmed otherwise by scanning or other investigations, columns may be assumed to be reinforced with a maximum of 1% steel times the gross plan area of the column.
- 1.5.7** The installation of advertising display framework structures, mobile phone antennae or similar dish structures, or towers atop any existing factory shall be critically examined against wind induced forces as specified by the Building Code of Pakistan (Seismic Provisions – 2007) using normal load factors. If a detailed structural assessment of the capacity of the structure to support such a tower indicates that the factory is adversely affected, then the tower shall be removed.

## **1.6 Remediation of Deficient or Overloaded Structural Elements**

**1.6.1** If the Preliminary Structural Assessment or more detailed structural investigations determine that structural distress in a structural member is due to inadequate structural capacity under applied loads, the Factory Owner shall take appropriate steps to remediate the overload by implementing one of the following methods:

1.6.1.1 The applied loads may be reduced to acceptable levels if possible by removal and limitation of structure, equipment, utilities, or floor loading, or,

1.6.1.2 Overloaded structural elements may be strengthened using properly designed, documented, and installed strengthening and retrofit, fully in accordance with Building Code of Pakistan (Seismic Provisions – 2007).

**1.6.2** All retrofits are subject to technical review by Chief Safety Officer prior to implementation.

**1.6.3** All installation of retrofit shall be accomplished by specialty firms experienced in the materials and techniques of structural retrofit. See Section 1.30.

**1.7 Phased Construction.** When a building or structure is planned or anticipated to undergo phased construction, structural members therein shall be investigated and designed for any additional stresses arising due to such effect.

***Interpretive Guideline:** Temporary or permanent loads due to construction phasing must be anticipated and analytically confirmed by a qualified structural engineer prior to any expansion.*

- 1.8 Restrictions on Loading.** The Factory Owner shall ensure that the live load for which a floor or roof is or has been designed, will not be exceeded during its use.
- 1.9 Factory Load Manager:** The Factory Owner shall ensure that at least one individual, the Factory Load Manager who is located onsite full time at the factory, is trained in the structural capacity and operational load characteristics of the specific factory. The Factory Load Manager shall be responsible to ensure that the factory operational loads do not at any time exceed the factory floor loading limits as described on the Floor Loading Plans.
- 1.10 Floor Loading Plans (Load Plans).** In every factory building, Load Plans shall be prepared for each floor. These Load Plans shall document the actual maximum operational loading that is intended and/or allowable on each floor. Load Plans shall include the items described in Section 1.20.4.3. The Load Plan for each floor shall be permanently and conspicuously posted on that floor. Load Plans are subject to review and approval by Pakistan Accord engineers. Sample load plan is included in Figure 1.20.
- 1.11 Floor Load Markings** In areas of factory buildings used for storage of work materials and work products, walls, columns, and floors shall be clearly marked to indicate the acceptable loading limits as described in the Load Plan for that floor.

***Interpretive Guideline:** Pakistan Accord inspections will confirm clear posting of floor live load plans and clear marking of storage areas. In recognition that load plans are not currently prepared or posted, initial Pakistan Accord inspections will be focused on helping the Factory Owner develop appropriate load plans based on the actual demonstrated floor capacity and operational utilization. The responsibility to produce and post load plans lies with the Factory Owner.*

**1.12 Load Factors and Load Combinations for Structural Analysis**

- 1.12.1** In analyzing the structural adequacy of existing factories, the load factors and load combinations described 5.12.2.1 of Building Code of Pakistan (Seismic Provisions – 2007) shall be used, noting that service level wind loads (i.e. unfactored) are applicable for concrete/ masonry structures and seismic loads are not considered as part of the existing factories under day to day loads.

**1.13 Confirmation of Actual Dead Loads**

- 1.13.1** Dead loads shall be confirmed by measurement as follows:
- 1.13.2** Slab thicknesses shall be measured at mid-span of representative slab spans on each floor.
- 1.13.3** Dimensions of representative sampling of beams shall be field measured.
- 1.13.4** Dimensions of representative sampling of columns shall be field measured.
- 1.13.5** Construction materials of walls shall be confirmed by representative exploration.

**1.13.6** Fixed service equipment and other permanent machinery, such as generators, water tanks (full), production equipment, electrical feeders and other machinery, heating, ventilating and air-conditioning systems, lifts and escalators, plumbing stacks and risers etc. may be considered as dead load whenever such equipment is supported by structural members and weights are confirmed by manufacturer's data sheets provided by Factory Owner for each piece of equipment.

#### **1.14 Confirmation of Actual Operational Live Loads**

**1.14.1** Operational live loads shall be confirmed by measurement as follows:

**1.14.2** For stored work materials, each type of material shall be weighed and measured.

**1.14.3** For stored work products, each size of boxed or packaged material shall be weighed and measured.

**1.14.4** For other types of live load, confirmation shall be accomplished in the most appropriate means in the judgment of the Pakistan Accord structural engineer.

**1.14.5** The live loads used for the structural design of floors, roof and the supporting members shall be the greatest applied loads arising from the intended use or occupancy of the building, or from the stacking of materials and the use of equipment and propping during construction but shall not be less than the minimum design live loads set out by the provisions of this section. For the design of new structural members for forces including live loads, requirements of the relevant sections of Building Code of Pakistan (Seismic Provisions – 2007) shall also be fulfilled.

#### **1.15 Minimum Floor Design Loads**

**1.15.1** Minimum floor design live loads for the review of factory sewing floors shall be 2.0kN/m<sup>2</sup> (42psf).

**1.15.2** Where density of operations, storage of materials, or equipment weights require live load capacity in excess of 2.0kN/m<sup>2</sup> (42psf), the Factory Owner shall engage a qualified structural engineer to analytically confirm that the structure achieves the needed load capacity.

**1.15.2.1** If the approved design documents for the factory construction do not explicitly confirm that the required load capacity exists, then the floor load capacity in the affected areas shall be analytically confirmed and certified by a qualified structural engineer.

**1.15.2.2** A certification letter with accompanying plans and calculations shall be prepared in accordance with Section 1.20 and made available at the factory site for review by third parties.

**1.15.3** For floors with design live load capacity of less than 2.0kN/m<sup>2</sup> (42psf) (such as residential floors converted to factory use) the floor live load capacity shall be clearly indicated on the Floor Load Plans required by Section 1.20.

**1.15.4** For areas of factory floors with actual operational live loads in excess of 2.0 kN/m<sup>2</sup>, a certification letter with accompanying plans and calculations shall be prepared in accordance with Building Code of Pakistan (Seismic Provisions – 2007) or Section 1.20 and shall be made available at the factory site for review by third parties.

## **1.16 Confirmation of Actual Construction Material Properties**

**1.16.1** Where practical, all preliminary and detailed structural assessments will preferably consider actual in-situ material strengths as measured by non-destructive and destructive testing in conformance with applicable ASTM testing protocols.

### **Key references:**

- *Reinforced concrete:*  
*ACI 214.4R-10 (Guide for Obtaining Cores and Interpreting Compressive Strength Results)*  
*ASTM, "C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete," ASTM International, 2020.*  
*ASTM, "C39/C39M-15a Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens," ASTM, 2021.*
- *Reinforcement: test in accordance with ASTM A615/A615M-22*
- *Structural steel: test in accordance with ASTM A370-22*

**1.16.2** Where field conditions allow and are acceptable in the judgment of the Pakistan Accord structural engineer, presumed minimum material strengths and characteristics may be used as follows.

Where testing has not been used to confirm actual properties and there is no sign of structural distress or deficiency in the subject member, the following minimum properties may generally be used, unless good engineering judgment indicates lesser properties should be assumed:<sup>4</sup>

- 1) Reinforced concrete (stone chip)–16.5MPa (2370 psi)
- 2) Reinforced concrete (masonry chip)–14.5MPa (2045 psi)
- 3) Reinforcing steel installed prior to 2004:–275MPa(40 ksi)

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<sup>4</sup> This data is based on concrete strength in Bangladesh. This data is therefore subject to revision when more reliable data can be collected in Pakistan.

- 4) Reinforcing steel installed from 2004 to present:– 415MPa (60 ksi)
- 5) A36 Structural steel – 248 MPa (36 ksi) yield strength

### **1.17 Design for Lateral Loads**

- 1.17.1** Every building, structure or portions thereof shall be designed to resist lateral loads due to wind in compliance with the forces, Load Factors and Load Combinations as stated in Building Code of Pakistan (Seismic Provisions – 2007).
- 1.17.2** When dead loads, live loads, and material properties are confirmed as described in Sections 1.13, 1.14, and 1.16, and there are no signs of distress due to loading, service level (i.e. unfactored) wind loads may be used as part of the assessment of existing concrete factory buildings.
- 1.17.3** A redundant structural system with clear load path to foundations to resist lateral loads is required in all existing factories. If such a load path does not exist, or if the factory has been vertically expanded, the lateral-resisting capacity of the factory shall be analytically confirmed and strengthened as required to resist lateral loads.
- 1.17.4** Any of the lateral loads prescribed in Building Code of Pakistan (Seismic Provisions – 2007), considered either alone or in combination with other forces, whichever produces the most critical effect, shall govern the design.
- 1.17.4.1 Confirmation of capacity of structures and components thereof to resist the effects of earthquake forces is not considered by this Standard.
- 1.17.5 Importance Factor.** Importance factor for all factory buildings and ancillary buildings shall be 1.0, unless hazardous materials are stored in the building. In that case, the importance factor shall be 1.5.

### **1.18 Seismic Bracing of Key Non-Structural Elements**

- 1.18.1** The following non-structural elements suspended from, attached to, or resting atop the structure shall be adequately anchored and braced to resist earthquake forces:
- 1.18.1.1 Gas pipes
  - 1.18.1.2 Chemical or process pipes
  - 1.18.1.3 Storage racks
  - 1.18.1.4 Water tanks
  - 1.18.1.5 Other suspended equipment weighing more than 1.8 kN that in the opinion of the Pakistan Accord structural engineer presents a danger to workers in an earthquake.
- 1.18.2** Seismic bracing for non-structural elements shall be designed using the requirements of Building Code of Pakistan (Seismic Provisions – 2007).



***Interpretive Guideline:** This requirement applies to both new and existing factories. It is intended to ensure that falling non-structural elements in a seismic event do not create life safety hazards or hindrances to building egress.*

### **1.19 Required Structural Documentation for New and Existing Factories**

- 1.19.1** Every factory requires structural documentation that accurately describes the factory structure.
- 1.19.2** Structural documentation shall be maintained at the factory site and made available to third parties assessing the structural safety of the factory.
- 1.19.3** All structural documentation shall be prepared and signed by the structural engineer responsible for the preparation of the documents.
- 1.19.4** New factories and any additions or expansions shall have complete structural documentation including Design Report and Structural Documents as described in Building Code of Pakistan (Seismic Provisions – 2007).
- 1.19.5** Existing factories shall have one of the following types of documentation:
  - 1.19.5.1** Complete and credible structural documentation prepared in general accordance with Building Code of Pakistan (Seismic Provisions – 2007) and used as a basis for the original construction of the factory building, or
  - 1.19.5.2** As-built structural documents that accurately describe the structural elements as described in Section 1.20.

***Interpretive Guideline:** It is recognized that few factory buildings have complete structural documentation. It is not intended that the Factory Owner produce complete structural documents after construction is complete. In this case, as-built documents will be required from field investigations as outlined in Section 1.20.*

### **1.20 Requirements for As-Built Documents**

- 1.20.1** For existing factories that lack complete and credible documentation, credible as-built documentation shall suffice. As-built documents shall be prepared in accordance with this Section.
- 1.20.2** The Factory Owner shall engage a qualified structural engineer (QSEC) to prepare accurate as-built documents from firsthand knowledge and personal investigation of the actual in situ factory construction and operational conditions.
- 1.20.3** The credibility of structural documentation shall be determined by the Chief Safety Officer on the basis of observations and tests at the factory.
- 1.20.4** As-built documents shall serve as the basis for any detailed structural analysis performed to confirm the capacity of structural elements and load plans.

**1.20.5** As-built documents shall include, at a minimum, the following:

1.20.5.1 Scaled and dimensioned Architectural Documents, including:

1.20.5.1.1 Scaled site plan showing:

- 1) general layout of all buildings in the complex with labels
- 2) location and names of adjacent streets
- 3) location and size of utilities, if known

1.20.5.1.2 Scaled architectural floor plan for each level of each building showing:

- 1) location and size of stairs
- 2) location and size of elevators
- 3) location of fixed walls
- 4) location of corridors
- 5) labeled usage areas on each floor, e.g., sewing, storage, dining, rooftop, office, etc.
- 6) Location of major machinery and equipment
- 7) General layout of factory activities

1.20.5.1.3 Scaled elevations of each façade of the building showing:

- 1) general configuration of the building
- 2) location and type of façade materials
- 3) accurate number of levels and any intended future vertical or horizontal expansion areas measured locations of columns and walls

1.20.5.2 Scaled and dimensioned Structural Documents as follows:

1.20.5.2.1 Floor Plan for each level showing:

- 1) measured locations of columns and walls
- 2) reinforcement details (rebar size and layout) for any columns determined using any scanning device or physical investigations. Columns at lowest tiers and rooftop are most useful to explore.
- 3) confirmed construction type of walls, e.g., masonry or cast concrete
- 4) general size and layout of beams
- 5) thickness of slabs
- 6) general size and location of major floor openings

1.20.5.2.2 Foundation Plan showing general layout and type of foundations, if known

1.20.5.2.3 Roof Plan showing any construction, equipment, water tanks, or tower added atop roof level.

1.20.5.2.4 Building section(s) showing all constructed floors, dimensions between floors, and intended future vertical or horizontal expansion, if any.

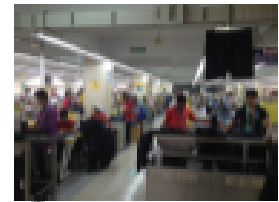
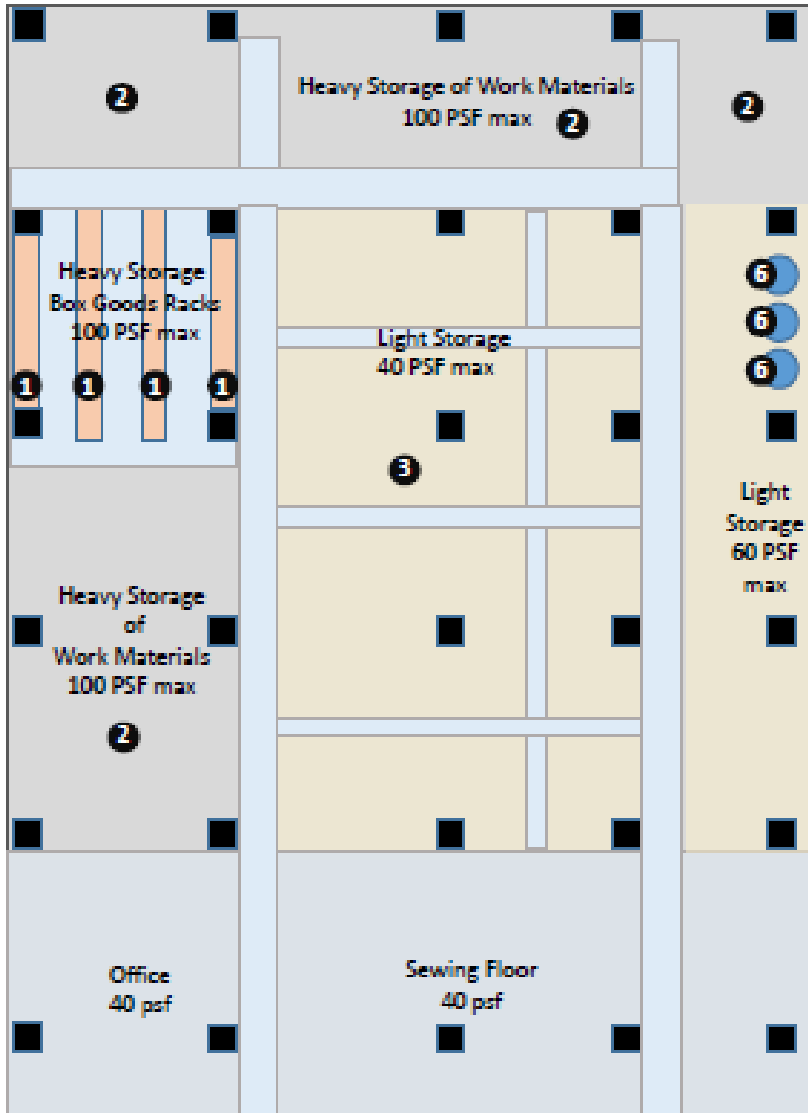
1.20.5.2.4.1 Building sections shall indicate location and extent of any mezzanines, suspended storage areas, or partial floors.

1.20.5.3 Factory Layout and Load Documents for every floor showing:

- 1) scaled layout of work stations

- 2) operating equipment
  - 3) dedicated aisle locations
  - 4) type and extent of storage areas
  - 5) type and weights of stored work materials and/or stored work products at maximum density
  - 6) Factory layout and loading documents may use the structural plan documents as background.
  - 7) Factory Layout and Load Plans shall be coordinated with the structural plans.
- 1.20.5.4 Example of factory layout and loading documents is included in Figure 1.20.

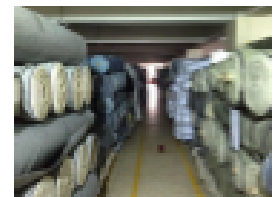
Figure 1.20: Sample load plan



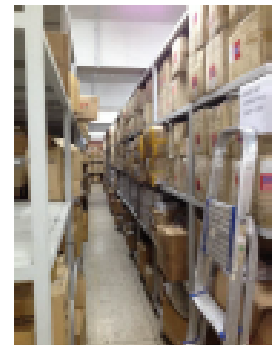
5 Sewing Operations



3 Bundled Box Stacks



2 Denim Rolls



1 Box Goods Rack

Typical Floor Loading for this Floor

No.	Type	Item	Max PSF Load	Description
1	HS	Box Goods Rack	120	W36" x H72", Max 6 boxes high, 15 kg/box
2	HS	Denim Rolls Storage	150	13" dia, 72" long, 150 kg/roll, 6 high max
3	LS	Bundled Box Storage	40	Max 48" high, 24" aisles each bay
4	Light	Office	40	W36 x H72, 6 boxes high, 15 kg/box
5	Light	Sewing Tables	40	Typical sewing tables
6	Special	Water tank	N/A	4000 lbs, 60" dia, 84" tall, 5,000 gal

NOTES:

HS = Heavy Storage

LS = Light Storage

All aisles minimum 48" unless noted.

Floor x Load Plan

Factory Name: \_\_\_\_\_ Prepared by: \_\_\_\_\_

Date Approved: \_\_\_\_\_ Approved by: \_\_\_\_\_

- 1.20.5.5 Factory Equipment Schedule, including:
- 1) Type of each piece of factory equipment including generators, washing machines, driers, etc.
  - 2) Include plan dimensions and weight of each piece of equipment.

### **1.21 Required Statement of Design Responsibility**

**1.21.1** The Factory Owner's engaged consultant (QSEC) shall provide written evidence of design responsibility, including calculations, design report, and documents as appropriate, for each of the following situations:

- 1.21.1.1 Structural expansions or modifications to existing factories.
- 1.21.1.2 Structural investigations or design confirmations of structural distress or suspected deficiencies.
- 1.21.1.3 Structural strengthening or improvements to comply with Code requirements  
Structural repairs of existing structural elements.

### **1.22 Construction Observation**

**1.22.1** Construction observation of all new construction, including new factory buildings, expansions of existing factory buildings, and repairs of existing factory buildings, shall be performed by the QSEC.

**1.22.2** Construction observation shall include, but not be limited to, the following:

- 1.22.2.1 Specification of an appropriate testing and inspection schedule prepared and signed with date by the responsible person;
- 1.22.2.2 Review of testing and inspection reports;
- 1.22.2.3 Regular site visits to verify the general compliance of the construction work with the structural drawings and specifications, and
- 1.22.2.4 Preparation of reports to document the results of observations and testing, including resolution of non-conforming construction.

**1.22.3** The quality and completeness of new construction, expansions, alterations, and repairs must be confirmed by independent observation and testing during construction.

**1.23 Notification to Accord of Planned Modifications to Factories.** Prior to the implementation of any substantial structural expansion, alteration, or repair of an existing factory utilized by Accord companies, the Factory Owner shall notify the Chief Safety Officer of his intent.

**1.24 Temporary Construction Loads on Existing Factories.** All loads required to be sustained by an existing factory structure or any portion thereof due to placing or storage of construction materials and erection equipment including those due to operation of such equipment shall be considered as erection loads.

- 1.24.1 Provisions shall be made in design to account for all stresses due to such loads.
- 1.24.2 When an existing factory will be expanded, all erection loads, and other construction loads shall be analytically confirmed and documented by an approved structural engineer.

*Interpretive Guideline: Temporary construction loadings on an existing factory during an expansion or other construction operations must not be allowed to endanger the life safety of building occupants through overloading elements of the factory. Construction loadings must be properly reviewed and managed.*

## **1.25 Site Investigation**

- 1.25.1 Application for construction of a new building or structure, and for the alteration of permanent structures which require changes in foundation loads and their distribution shall be accompanied by a statement describing the soil in the ultimate bearing strata, including sufficient records and data to establish its character, nature and load bearing capacity. Such records shall be certified by an approved structural engineer in accordance with Section 1.21.
- 1.25.2 Prior to vertical expansion of an existing factory, an approved structural engineer (QSEC) shall provide analytical confirmation and documentation that the foundations supporting the factory have adequate capacity to safely support the additional loads due to the expansion.

## **1.26 Durability and Maintenance**

- 1.26.1 Factory Owner shall attend to all areas of needed maintenance, including areas with efflorescence, dampness, and corrosion.
  - 1.26.1.1 Standing water on rooftop or other locations shall not be permitted.
  - 1.26.1.2 Roofs shall be sloped to drain with minimum drainage of 1%.
  - 1.26.1.3 Drains shall be provided at low points.
  - 1.26.1.4 All exposed reinforcement (kept for possible future expansion) shall be protected from weathering effect and rust by using approved protective covering.

## **1.27 Qualifications of Testing Laboratory**

- 1.27.1 Where testing of in situ structural elements or materials or construction materials is required to confirm strength or other characteristics, this testing shall be performed in accordance with applicable ASTM specifications by a qualified testing laboratory that meets the requirements of Section 1.27.

- 1.27.2** The Testing Laboratory shall meet the basic requirements of ASTM E 329 and shall provide to the Pakistan Accord evidence of current accreditation from the American Association for Laboratory Accreditation, the AASHTO Accreditation Program, the “NIST” National Voluntary Laboratory Accreditation Program, or an equivalent Pakistan certification program.
- 1.27.3** The Testing Laboratory shall be approved by the Pakistan National Accreditation Council or other relevant certification body to perform Special Inspections and other tests and inspections as outlined in the applicable building code.
- 1.27.4** Tests and inspections shall be conducted in accordance with specified requirements, and if not specified, in accordance with the applicable standards of the American Society for Testing and Materials or other recognized and accepted authorities in the field.

### **1.28 Qualifications of Welding Inspectors**

- 1.28.1** Inspectors performing visual weld inspection shall meet the requirements of AWS D1.1 Section 6.1.4. Inspectors shall have current certification as required by Pakistani law and Building Code of Pakistan (Seismic Provisions – 2007).
- 1.28.2** Inspectors performing non-destructive examinations of welds other than visual inspection (MT, PT, UT, and RT) shall meet the requirements of AWS D1.1, Section 6.14.6.

### **1.29 Retrofitting of Deficient Structural Elements**

- 1.29.1** When a structural member is identified to have inadequate structural capacity and the applied loadings cannot or will not be reduced to allow the structural member to be acceptable, then structural retrofitting may be accomplished in accordance with this section.
- 1.29.2** Structural retrofitting shall be properly design using industry-standard methods.
- 1.29.3** Retrofitted elements must be strengthened to provide adequacy under all imposed and anticipated loads using the load factors specified in 5.12.2.1 of Building Code of Pakistan (Seismic Provisions – 2007).
- 1.29.4** Beam and slab cracks may be repaired by epoxy injection using techniques prescribed in ASTM.
- 1.29.5** Beam and slab strengths may be supplemented by using properly designed and installed Ferro cement, micro-concrete, or FRP solutions.
- 1.29.6** Standard retrofit techniques such as concrete jacketing, micro-concrete encasement, FRP-wrapping, etc. may be used for strengthening of columns.
- 1.29.7** Where columns are strengthened the load path through floors and joints must be carefully accommodated.
- 1.29.8** Column slenderness may be reduced by installing properly designed lateral bracing systems.

**1.29.9** All retrofitting shall be overseen by the responsible QSEC.

**1.30 Qualifications of Retrofitting Installation Firms**

**1.30.1** All firms used for installation of structural retrofitting elements shall be specialty construction firms with a minimum of five (5) years of experience in this area.

**1.31 Qualification of QSEC**

**1.31.1** Subject to approval by the Accord, the minimum qualification and experience of the QSEC to be engaged by the factory owner to undertake further detail assessment or design of remediation work shall be as follows:

- 1) Shall be graduate in civil engineering from a recognized university.
- 2) Shall have minimum 10 years of structural design experience.
- 3) Shall have professional license to undertake structural design of building structure in Pakistan i.e., a membership of the Pakistan Engineering Council, license from the Sindh Building Controller's Authority and/or relevant authorities in the Province of Punjab is required.
- 4) The engineering firm involved must have at least ten years of experience in structural analysis and retrofitting of existing structures.