BUILDING DEPARTMENT

303 East B Street, Civic Center, Ontario, CA 91764 Phone (909)395-2023, Fax (909)395-2180

STORAGE RACKS CORRECTIONS LIST (2010 California Codes)

Plan Check No. B2011	**Review No:**	**Plan Check Expiration Date: 1 year from submittal**
Site Address:		
Project Description:		Area square feet:
Type of Occupancy:		High wind region:
Type of Construction:		

Applicant:	Phone:
Owner:	Phone:
Architect/Engineer:	Phone:

Reviewed by:	Date:	Ph: (909)395- , e-mail: ---------@ci.ontario.ca.us

INSTRUCTIONS:

⇒ **Numbers in brackets refer to code sections of 2010 California Building Code [CBC], RMI MH16.1:2008 Specifications for the Design, Testing, and Utilization of Industrial Steel Storage Racks [RMI], ACI 318-08 Building Code Requirements for Structural Concrete [ACI], and ASCE/SEI 7-05 Minimum Design Loads for Buildings and Other Structures [ASCE].**

⇒ **Correct original drawings. Reprint and submit 2 new sets together with the "marked-up" set. Return this corrections list with corrected plans.**

⇒ **In the Respond column, please indicate the sheet number and detail or note number on the plan where the corrections are made.**

⇒ **Itemize any changes, revisions, or additions made to drawings that are not a direct answer to a correction on a separate sheet.**

⇒ **Additional plan check fee will be required after third review on hourly rate basis.**

Item #	Sheet #	Correction Requested	Respond
	A. APPLICATION:		
1		Valuation is low. Additional Plan check fee is required prior to resubmittal.	
2		Separate permit is required for_____.	
	B. APPROVALS:		
3		Obtain Fire Department approval.	
4		Obtain Planning Department approval for exterior racks.	
	C. HAZMAT:		
5		Fill out the attached Hazardous Material Disclosure form & print on	

		plan the completed form.	
6		The submitted Hazardous Material Disclosure form indicates that hazardous material in excess of the exempt amount. Provide a list of hazardous material indicating quantity & classification stored or used within the facility in similar format to CBC Tables 307.1(1) and 307.1(2). Such facility and areas shall be designed and constructed in accordance with CBC section 307 for group H occupancy.	
	D. CODES:		
7		Storage racks must be designed to comply with 2010 CBC section 2208.1 which refers to *RMI/ANSI MH 16.1:2008 Specification for the Design, Testing, and Utilization of Industrial Steel Storage Racks*.	
8		a) Building permit is <u>not required</u> for storage racks less than 5'-9" in height. [CBC 105.2 item 13]. b) Building permit is <u>required</u> for storage racks over 5'-9" but less than 8'-0" in height [CBC 105.2 item 13]. Submit floor plan showing racks layout, aisle & cross aisle dimension, and racks anchorage to concrete slab as per manufacturer specifications. c) Building permit is <u>required</u> for storage racks over 8'-0" in height [CBC 105.2 item 13, RMI 2.6.1]. Submit structural plans, details, and calculations prepared by a licensed engineer.	
	E. PLANS:		
9		Indicate on plan the applicable codes i.e. 2010 California Building Code, ASCE/SEI 7-05, ACI 318-08, and RMI/ANSI MH 16.1:2008.	
10		Indicate on plan building type of occupancy, type of construction, and indicate if building is equipped with fire sprinkler system.	
11		Provide a key plan showing property lines, street names, and location of building with the proposed storage racks.	
12		Provide overall building floor plan to show location of the proposed racks, all exit doors, aisle and cross aisle width.	
13		Identify on floor plan each type of racks to coincide with structural calculation.	
14		a) Provide a fully dimensioned floor plan so that egress can be verified. b) Show on plan the <u>common path of egress travel</u> not to exceed [CBC 1014.3]: 1) 25' for Group H-1, H-2, and H-3 occupancies. 2) 75' for other Groups. 3) 100' for Group B, F, and S occupancies with an automatic sprinklered system. 4) 100' for Group B, S and U occupancies with occupant load of 30 maximum. c) Also show on plan the <u>exit access travel distance,</u> measured from the most remote point to an exit, not to exceed the allowable per CBC Table 1016.1.	
15		a) Indicate on floor plan location and size of existing building columns. b) Indicate dimension on floor plan racks clearance to any building columns and walls.	
16		All sheets of plan must be stamped & wet signed by the engineer.	
17		Rack layout floor plan must be stamped & wet signed by the engineer.	
18		Indicate on floor plan clearly that the scope of this permit is for	

		storage racks only.	
19		Remove details and notes that are not applicable.	
	F. GENERAL NOTES:		
20		Provide on plan the following <u>general notes</u>: a) Indicate rack capacity per RMI 2.6.2 showing: 1. The maximum permissible unit load and/or maximum uniformly distributed load per level, 2. The average unit load ($PL_{average}$, see RMI section 2.6.2) if applicable and 3. The maximum total load per bay. b) Indicate concrete slab thickness and strength design. c) Indicate the allowable soil bearing pressure design. d) Specify weld electrodes. e) Indicate that all welding must be done in approved fabricator shop, no field welding performed. Special inspection is required for any field welding. f) All welding, except when performed at the shop of an approved fabricator, shall be done by certified welders. g) Provide a permanent plaque each not less than 50 square inches in area in one or more conspicuous location for each type of racks [RMI 1.4.2] showing: 1. The maximum permissible unit load and/or maximum uniformly distributed load per level, 2. The average unit load ($PL_{average}$, see RMI section 2.6.2) if applicable and 3. The maximum total load per bay. h) The maximum top to bottom out-of plumb ratio and out-of straight ratio rack column is 1/240 (for example ½" per 10 feet of height). Column whose out-of- plumb ratio or out-of straight ratio exceeds this limit should be unloaded and re-plumbed. Any damaged parts must be repaired or replaced. [RMI 1.4.11] i) Indicate the minimum distance to be provided from racks to any adjacent building component. [ASCE 15.5.3.4] j) <u>Periodic</u> special inspection is required during the anchorage of storage racks 8 feet or greater in height in structures assigned to Seismic Design Categories D, E, or F. [CBC 1707.5] k) Special inspection is required <u>for storage racks and their anchorage</u> where the Important Factor is equal to 1.5 such as racks installed in structures open to the public e.g. warehouse retail stores [CBC 1705.3.4 item 5, ASCE7-05 15.5.3.1, RMI 2.6.2]. l) Special inspection is required for installation of concrete anchor bolts as per ICC report. m) Indicate the minimum distance between the anchor bolt center to any construction joints, control/expansion joints, or slab cracks. n) Indicate the concrete slab test report number & date (if any).	
21		Provide the following notes on plan per RMI 1.4.1. The owner shall maintain the structural integrity of the rack system by assuring proper operational, housekeeping, and maintenance procedures, but not limited to, the following: a) Prohibit any over loading of any pallet positions and of the	

		overall rack system. b) Regularly inspect for damage. If damage is found, immediately unload the affected area and replace or repair any damaged columns, beams, or other structural components. c) Require all pallets to be maintained in good, safe, operating condition. d) Ensure that pallets are properly placed onto pallet load support members in properly stacked and stable position. e) Require that all goods stored on each pallet to be properly stacked and stable. f) Prohibit double stacking of any pallet position, including the top most position, unless the rack system is specifically designed for such loading. g) Ensure that the racks are not modified or rearranged in a manner not within the original design configurations.	
22		Provide material specifications for: a) Concrete b) Steel c) Welds d) Bolts	
23		Provide ICC approval number for concrete anchor.	
24		Grade 2 or 5 bolts are not permitted for structural use. Grade 2 & 5 bolts are listed for automotive application only.	
	G. RACK DESIGN:		
25		Seismic response coefficient, Cs, shall be determined per RMI 2.6.3: a) $Cs = \frac{S_{D1}}{T\,R}$, where: R= 4.0 in the braced direction and R= 6.0 in the unbraced direction. b) Alternatively, Cs need not be greater than $Cs = \frac{S_{DS}}{R}$ c) Cs shall not be less than $0.044\ S_{DS}$. d) Additionally, when $S_1 \geq 0.6$, Cs shall not be less than $Cs = \frac{0.5\ S_1}{R}$	
26		Racks shall be designed for each of the following conditions of operating weight, W or W_p [RMI 2.6.8 and ASCE 15.5.3.2]: a) Weight of the rack plus every storage level loaded to 67% of its rated load capacity. b) Weight of the rack plus the highest storage level only loaded to 100% of its rated load capacity. c) The design shall consider the actual height of the center of mass of each storage load component.	
27		The factor k is permitted to be taken as 1.0. [ASCE 15.5.3.3 item c]	
28		a) Indicate separation between racks and building components. The assumed total relative displacement for storage racks shall not be less than 5% of the height above the base. [ASCE 15.5.3.4] b) Seismic separation of racks from building walls, columns, etc shall comply with ASCE 7-05 section 15.5.3.4.	
29		Racks exposed to the wind shall be designed for the wind loads acting on the rack and the loaded pallets. For stability, consideration is to be given to loading conditions which produce large wind forces combined with small stabilizing gravity forces. [RMI 2.5]	
30		Use the correct system Important Factor I_p [RMI 2.6.2]: a) $I_p = 1.5$ if the system is in an essential facility. b) $I_p = 1.5$ if the system contains material that would be	

		significantly hazardous if released. c) I_p = 1.5 for storage racks in areas open to the general public, e.g. in warehouse retail stores. d) I_p = 1.0 for all other structures.	
31		• For ASD design method use the load combinations as specified in RMI 2.1. • For LFRD design method use load combination as specified in RMI 2.2.	
32		Storage racks located at level above the ground level or racks which depend upon attachments to buildings or other structures at other than floor level for their lateral stability, shall be designed to resist seismic forces that consider the responses of the building and storage rack to seismic ground motion and their interaction so as not to cause damage to one another. [RMI 8.3]	
33		Where racks are braced to the building structure, the building structure shall be designed for the horizontal and vertical forces imposed on the building structure. [RMI 1.4.10 and 8.2]	
34		Seismic separation of racks from building walls, columns, etc shall comply with ASCE 7-05 section 15.5.3.4.	
	H. BEAMS:		
35		At working load (excluding impact) the deflections shall not exceed 1/180 of the span measured with respect to the beam ends. [RMI 5.3]	
36		Load-supporting beams and arms and end connector components used to attach them to columns are to be designed for additional vertical impact load of 25% of one unit load. [RMI 2.3]	
37		The beam-to-column connections, frame bracing members and frame bracing connections must be designed for the more critical of [RMI 2.4.1]: a) Earthquake forces (see RMI 2.6) b) Wind forces (see RMI 2.5) c) For Allowable Stress Design: 1.5% DL plus 1.5% PL based on maximum loading. For Load and Resistance Factor Design: 1.5% factored DL plus 1.5% factored PL based on maximum loading.	
38		For load support beams and their connection design use the following load combination: • DL + LL + 0.5 (SL or RL) + 0.88PL + IL for ASD design method [RMI 2.1 item 5]. • 1.2DL + 1.6LL + 0.5 (SL or RL) + 1.4PL + 1.4IL for LFRD design method [RMI 2.2 item 5]	
39		Except for moveable-shelf racks, beams shall have connection locking devices (or bolts) capable of withstanding an upward force of 1,000 pounds per connection without failure or disengagement. [RMI 7.1.2]	
40		For moveable shelf racks, the top shelf and other fixed shelves are to include support connection capable of supporting an upward force of 1,000 pounds per connection without failure. [RMI 7.1.3]	
	I. COLUMNS:		
41		The effect of perforations on the carrying capacity of compression members shall be recognized by modification of the Q-factor. [RMI 4.]	
42		The bottom of all columns shall be furnished with column base plates designed in accordance with RMI section 7.2. [RMI 1.4.7]	

	J. UPRIGHT FRAME DESIGN:		
43		For racks <u>not braced</u> against side sway the effective length factor K shall be 1.7 for the portion of the column between the bottom beam and the floor as well as between the beam levels. [RMI 6.3.1.1]	
44		For racks <u>braced</u> against side sway the effective length factor K shall be 1.0 provided such racks have diagonal bracing in vertical plane and have either a rigid and fixed top shelf or diagonal bracing in the horizontal plane of the top fixed shelf. [RMI 6.3.1.2]	
45		The effective length factor K_t for torsional buckling shall be taken as 0.8 provided that the connection details between the columns and the braces are such that the twisting of the column is prevented at the brace points. [RMI 6.3.3.2]	
46		Check the stability of trussed-braced upright frames per RMI 6.4.	
	K. VERTICAL DISTRIBUTION OF SEISMIC FORCES:		
47		The lateral force, F_x at any level shall be determined in accordance with RMI 2.6.6: a) If the centerline of the first shelf level is ≤ 12" above the floor: $F_1 = C_s\, I_p\, w_1$ for the first shelf level, and $F_x = \frac{(V - F_1)\, w_x h_x}{\sum_{i=2}^{n} w_i h_i}$ for levels above the first level b) If the centerline of the first shelf level is > 12" above the floor: $F_x = \frac{V\, w_x\, h_x}{\sum_{i=1}^{n} w_i h_i}$ for all levels	
	L. OVERTURNING:		
48		Provide overturning analysis to comply with RMI 2.6.8 or ASCE 15.5.3.2: a) Weight of the rack plus every storage level loaded to 67% of its rated load capacity. b) Weight of the rack plus the highest storage level only loaded to 100% of its rated load capacity. The design shall consider the <u>actual height of the center of mass</u> of each storage load component.	
49		Provide calculation to determine the number & size of row spacer.	
	M. COLUMN BASE PLATES:		
50		The maximum allowable bearing stress F'_p (ASD) or design bearing load $\emptyset_c P_p$(LFRD) on the bottom of the plate shall be determined per RMI 7.2.1: • $F'_p = 0.7\, f'_c$ for ASD • $P_p = 1.7\, f'_c\, A_{Effective\ Base\ Bearing\ Area}$ for LFRD $\emptyset_c = 0.60$ Where $f'_c = 3{,}000\ psi$ (assumed)	
51		The base plate thickness shall be designed for the following loading conditions per RMI 7.2.2: a) Assume the bearing pressure is uniformly distributed over the effective baseplate area and the base plate shall be analyzed as a rigid member. [RMI 7.2.2.1] b) When the base plate configuration uses a <u>single anchor bolt</u> and a net uplift force exists, design based on bending moment in the plate equal to the uplift force times ½ the distance from the centerline of the anchor to the nearest edge of the column. [RMI 7.2.2.2]	

		c) When the base plate configuration consists of <u>two anchor bolts</u> located on either side of column and a net uplift force exists, design based on bending moment in the plate equal to <u>uplift force on one anchor</u> times ½ the distance from the centerline of the anchor to the nearest edge of the rack column. [RMI 7.2.2.2] d) When downward axial loads and bending moment due to lateral loads exist: 1. When $e = \frac{M}{P} \leq \frac{N}{6}$ where N = effective length of base plate in the down-aisle direction, no uplift of base plate will occur. Therefore, no tension force will be present in the anchors and the anchor shall be designed for the maximum calculated shear force. The base plate thickness shall be determined as in RMI 7.2.2.1. 2. When $e = \frac{M}{P} > \frac{N}{6}$ where N = effective length of base plate in the down-aisle direction, then a tension force may occur in the anchor(s). The concrete stress block distribution & magnitude to be established to determine the anchor tension by equation of equilibrium. The base plate thickness shall be determined as in RMI 7.2.2.1.	
52		The base connection shall have a rotational capacity not less than the rotational demand of the beam-to-column connection, Θ_D as calculated in RMI 2.6.4. Otherwise the base connection shall be considered as <u>pinned</u> for computation of the period and seismic displacement.	
53		Shims may be used under the base plate to maintain the plumbness of the storage rack. If shims are used, add the following notes on plan: a) Shims shall be made of a material that meet or exceeds the design bearing strength (LFRD) or allowable bearing strength (ASD) of the floor. Specify on plan the shim material. b) Shims size and location under base plate shall be equal to or greater than the required base plate size and location. c) The total thickness of shims shall not exceed 6 times the diameter of the largest anchor bolt. d) Shims with a total thickness ≤ 6 times the anchor bolt diameter with less than 2 anchor bolts shall be interlocked or welded. Provide typical detail to illustrate. e) Shims with a total thickness ≤ 2 times the anchor bolt diameter need not be interlocked or welded. Provide typical detail to illustrate.	
	N. SLAB-ON-GRADE		
54		a) Limit racks uplift to 300 lbs max per post for unreinforced or under reinforced concrete slab-on-grade (per City Policy). b) Limit racks uplift to 1,500 lbs max per post when in-situ compressive & uplift concrete slab test performed with a factor of safety 4.0 (per City Policy).	
55		Provide anchor sizing calculation per ACI 318-08 appendix D. Design strength of anchor must be reduced by multiplying the allowable load by 0.75 as required by ACI appendix D.3.3.3. Anchors shall be designed to be governed by the steel strength of a ductile steel element [CBC 1912.1, 1908.1.9, ACI appendix D.3.3.3]	

56		• Structural plain concrete slab shall be designed using load factors and design strength [CBC 1909.1, ACI chapter 22]. • Factored loads and forces shall be in combinations specified in ACI 9.2.1. • Check concrete slab for beam action shear, punching shear, and bearing [ACI 22.5.3, 4, & 5]. • Strength reduction factor (Ø) for flexure, compression, shear, and bearing of structural plain concrete shall be Ø = 0.60 [ACI 9.3.5]	
	O. ADDITIONAL COMMENTS:		